Board of Natural Resources
Colstrip Hearings

Volume 18
Transcript of Proceedings

January 26, 1976

I N D E X

Colstrip 3 & 4

MONDAY, JANUARY 26, 1976

The hearing reconvened at 1:45 P.M. on Monday, January 26, 1976, in the Chambers of the Montana House of Representatives, State Capitol, Helena, Montana.

The Honorable Carl M. Davis, Hearings Examiner, presided over the proceedings.

APPEARANCES:

Applicants:

William M. Bellingham, Esq.
John L. Peterson, Esq.
John Ross, Esq.

Department of Natural Resources and Conservation:

William G. Sheridan, Esq.
Donald MacIntyre, Esq.

The following proceedings were had:

HEARINGS EXAMINER: Are you ready to proceed, gentlemen?

MR. BELLINGHAM: The applicants are ready.

MR. SHERIDAN: The department is ready.

MR. BELLINGHAM: Mr. Kent Anderson is ready to be sworn in.

Dr. KENT P. ANDERSON, called as a witness by the Applicants, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

MR. BELLINGHAM: A copy of Mr. Anderson's written testimony has been turned over to the reporter, and at this time, we would like to point out one correction at page 24, line 1, the year 1963, as it reads there, should be 1973.

HEARINGS EXAMINER: Is that on line 1?

MR. BELLINGHAM: Yes.

HEARINGS EXAMINER: Do you have any exhibits with this one?

MR. BELLINGHAM: There are no exhibits.

(THE WRITTEN DIRECT TESTIMONY OF DR. KENT P. ANDERSON WAS DIRECTED TO BE INSERTED AT THIS POINT.)

TESTIMONY

OF

KENT P. ANDERSON

My name is Kent P. Anderson and my business address is 555 South Flower Street, Los Angeles, California. I am a senior consultant for National Economic Research Associates, Inc., an economic consulting firm specializing in the economics of energy, the environment, anti-trust and labor. I received my B.A. degree in economics from the University of Michigan in 1964. I received my Ph.D. in economics in 1968 from the Massachusetts Institute of Technology.

From 1968 until late 1974 I was a member of the research staff at the Rand Corporation in Santa Monica, California. While at the Rand Corporation I conducted research in a variety of fields including the economics of national defense, economic growth and development, and the economics of energy. My energy-related research at the Rand Corporation included econometric analysis of residential and industrial energy demands, evaluation of electric energy policy in California, studies of future energy supply conditions and costs, and a simulation analysis of the nation's energy markets to 1995.

Since joining National Economic Research Associates, Inc. in late 1974, I have assisted clients in evaluating information about the relationship between income and

energy consumption, in assessing the strengths and weaknesses of estimates of electricity demand elasticity (e.g., reponses of users to changes in price), and in judging alternative rate design concepts. I have coordinated and written much of the forthcoming Technical Advisory Committee Report to the Federal Power Commission on the potential problems of inadequate electric power supplies and I am involved in further research to estimate demand relationships for electricity and other forms of energy which incorporate price "elasticity" effects.

A number of my studies have been published as reports of the Rand Corporation including three studies of the effects of price upon energy demand. In addition, I have also published articles in the Journal of Economic Theory and the Journal of Business.

The first subject I would like to take up is the methods for, problems of, and uncertainties in electricity demand forecasting. Most utilities today, as they have in the past, place a heavy reliance upon trend extrapolation to project loads. This method assumes that the rates of change of the quantities to be projected can be estimated from past rates of change. Utilities, however, vary considerably in their choice of variables to extrapolate. Some directly trend peak loads, others trend average system loads or total energy sales. Customer classes may or may not be distinguished. Some utilities do

separate trend analyses of energy sales per customer on the one hand and number of customers on the other, in which case they also distinguish customers by class. When converting energy sales forecasts to corresponding peak loads, utility companies almost invariably rely upon historical trends in load factors. In many cases, companies will do a relatively detailed analysis for near-term projections and extrapolate the results to obtain longer term forecasts.

Many other variations appear more or less commonly in the forecasting methods used. They include separation of historical loads or consumption into weather sensitive and "base" or "normalized" components; extrapolation of monthly rather than annual data; performance of a customer-by-customer review of large industrial customers' plans; use of demographic studies from the Bureau of the Census or state population agencies to project population or numbers of customers; use of more than one approach--for example on one hand, forecasting energy sales by classes and then converting to system peak load and on the other, directly extrapolating peak load; and finally extrapolation of saturations and usage for a variety of household functions.

The effects of future energy price changes, of possible alterations in the growth of output and income, or of shifts in demographic trends--when given explicit consideration in company forecasts--are usually estimated

on the basis of informal analysis (historical experience, intuition, discussions with knowledgeable industry experts, and so on).

The method by which the Montana Power Company forecasts its loads is as follows: First, the company separates the total load into a "base" component and a "block" component. The latter consists of a small number of large industrial users whose loads have exhibited no discernible trend over the years. Future loads for this group, both peak and average energy, are projected on a customer-by-customer basis. Future loads for the remaining component, the "base" component, are projected by means of trend extrapolation. For the most recent forecast the trend is derived from data for the 1952 through 1971 period. Both peak and average energy loads are projected for this component as well as for the "block" load component. Overall, Montana Power's methods of forecasting loads are similar to those traditionally employed by most other utility companies.

Perhaps the two greatest strengths of the load forecasting techniques generally employed by utilities are: (1) their simplicity, and (2) their historical record of accuracy. Data requirements are minimal; the procedures involved in making the projections are straightforward and easily understood; and these procedures have, in the past, yielded reasonably accurate forecasts for planning purposes.

There are, however, two weaknesses that pervade the trend extrapolation approach--the risk of error when underlying conditions deviate from past trends and the inability to handle many "what-if" questions. Until recently, many factors combined to promote a steady and rapid growth of electricity sales: a declining price of electricity relative to the price of goods and services in general and to fuel prices in particular; a declining price for many types of electrical equipment relative to prices in general; a rather steadily rising level of economic activity and income; population growth; and development of new industrial technologies or processes favoring the use of electricity. In the future some of these influences may weaken or be reversed, others may become more important.

At National Economic Research Associates, Inc. (NERA) we are at present taking a somewhat different approach to electricity demand forecasting from that typically used by utilities in the past. Our approach might be called a "behavioral" approach, in that our electricity demand estimates are based directly upon the underlying economic and demographic factors that influence the consumption behavior of different types of electricity users. This type of approach does not eliminate the problem of extrapolating or otherwise predicting trends. Reliance upon historical trends cannot be escaped entirely. In our case it is necessary to project future values for the underlying explanatory

factors. These projections depend in part upon past trends.

If so, why should we bother with the behavioral approach? First, we may be able to obtain better extrapolations or projections of the underlying factors than of demand itself and hence, we may be able to have more confidence in the outcome of the projection. However, I do not generally believe that to be the case with respect to the problem of forecasting electricity demand. It is probably equally difficult to forecast economic growth or population growth. The second reason is that the behavioral approach allows us to answer the "what-if" types of questions I mentioned earlier. This, in turn, may help us to evaluate contingencies or breaks in trends more effectively. Yet one of the consequences of the behavioral approach is that there is often more apparent uncertainty in the forecast than with the traditional utility approach because of the number of "variations" or "cases" that are generated as one goes through the "what-if" possibilities.

In a sense, use of the behavioral approach makes the planning for future system load growth more difficult, and it serves to emphasize the need for a sophisticated approach to system planning. In particular, it shows that any system expansion plan faces a certain risk of overestimating load and hence of over-building capacity--or on the contrary, underestimating load and hence of under-building capacity.

The actual rate of expansion of the system, given the alternative rates of growth that may in fact take place, must depend on an evaluation of the relative costs of over-building versus under-building.

In the case of under-building, the likely result is that electricity users will be forced to curtail consumption in various unpleasant ways, including having to muddle through brown-outs and black-outs. The cost of under-building can therefore be quite high. The cost of over-building--given that electricity growth is going to occur at some positive rate in the future even if not as high as it has occurred in the past--are the costs of carrying unused or under-used productive capacity for a period of time. The net effect would be to increase average electricity costs temporarily while capacity was under-utilized. As capacity utilization increased, this effect would diminish toward zero. Except in the case of relatively small errors, the costs of being above the mark in load forecasting are likely to be considerably lower than those of being an equal amount below the mark.

There are several major limitations that can be identified in the behavioral approach to electricity demand forecasting. The first is that behavioral relationships, as they have been developed to date, are capable of explaining annual kilowatt-hour sales but not peak loads. To develop similar relationships for forecasting system

peak load raises difficult problems, since the system peak is the maximum sum of customer loads not the sum of maximum customer loads. It is not sufficient to develop relationships to explain non-coincident class peak loads or even individual customer peak loads. Ultimately required is a set of relationships to explain the contribution to system peak load by each customer or class, and it is by no means clear, given currently known statistical techniques, that these relationships would be better predictors than one which converted annual or monthly sales figures to peak loads by simple projections of load factors. To determine separate behavioral relationships for kilowatt-hour sales during peak seasons or months might prove useful. Data inadequacies have tended to limit advances in this area but could probably be overcome. The practice of forecasting peak load on the basis of sales figures of course presents no major problem as long as customer load factors are stable or trends in the load factors can be predicted with a reasonable degree of accuracy.

A second limitation of the behavioral approach is that the relationships estimated to date provide little or no information about how customer usage would be affected by changes in the structure as opposed to the level of rates. Nearly all studies use average-price or typical-bill data to define a single measure of the user cost of electric service. As long as rate structures continue to conform

more or less closely to historical patterns, this presents no serious difficulties. If, in the future, rate increases are combined with major alterations in rate structure, the predictions of "single price" relationships may be unsatisfactory. But the obvious dearth of notable variation in rate structures over time since World War II and the general similarity of rate structures throughout the country make it difficult, if not impossible, to predict responses to rate structure changes through statistical analyses of historical experience.

A third limitation has to do with the difference between long-term and short-term responses to changes in such explanatory factors as prices, income and household size. By short-term response I mean the kinds of adjustments that customers can make immediately after a price change. They could include changing the level of the thermostat, using the equipment less often, maintaining it better and so on. Long-term responses, by contrast, are those responses that can come into effect only when sufficient time has elapsed for users to find it economic to replace old energy-using equipment with new energy-using equipment, to renovate old systems or even to replace the building in which the equipment is used. Long-term responses therefore include such adjustments as switching from one fuel to another, switching from larger to smaller units and shifting from units that are less

efficient in the use of energy to units that are more efficient in the use of energy. Long-term responses are tied to the typical economic lives of energy-using equipment and buildings. Depending on the type of equipment involved, we could be talking about a long-term of anywhere from five to thirty years.

Most statistical analyses of behavioral demand relationships have focused on explanation of the long-term adjustments of users to differences in price, income and other factors, and much has been learned about these responses. These results have been achieved primarily by comparing how users in one part of the country have adjusted over time to conditions in that part of the country with how energy users have adjusted to conditions in other parts of the country. Statistical analysis of short-term responses has been hampered by the generally smooth time trends of many of the explanatory factors. The smoothness of these trends has made it difficult to sort out the separate effects of short-term fluctuations in each factor. Some investigators have attempted to estimate short-run and long-run elasticities by combining regional and time series data. This is a clever approach, but one must usually make some quite restrictive assumptions in order to accomplish the estimation; and the data requirements are formidable. The results that have been obtained to date by this method are not entirely satisfactory.

There are two important points to emphasize in connection with short-term and long-term responses: First, it is important to make clear whether we are talking about a long-term or a short-term response. Second, for long-term planning purposes we can often safely rely on estimates of long-term responses since short-term fluctuations are of lesser importance when considering the problems of planning over a ten- to twenty-year planning horizon.

A fourth, and very important limitation to the process of estimating behavioral relations is that imposed by the available statistical procedures and data. The kinds of mathematical relationships that can be estimated with these procedures and data are very limited, and in most cases we are not actually estimating what one might call the "real world" relationship but rather an approximation to that relationship. We must hope that it is reasonably accurate for the purposes to which it will be put.

There are, of course, numerous other lesser limitations and problems in estimating behavioral relationships. Most of these are specific to the individual user classes for which demand relationships are estimated. It is important to divide customers into groups or classes whose behavior patterns are likely to be somewhat similar. In practice this has meant breaking consumption down into the familiar categories, residential, commercial and

industrial. In our work at NERA we have further broken down industrial demand according to industry type.

In the residential sector, our models for predicting residential sales treat residential customers as a single group although it is obvious that households' lifestyles and energy consumption patterns vary considerably. This problem is dealt with in two ways: One is by including measures of typical household characteristics for each region or time period as explanatory factors in the demand relationship. Such characteristics may include household income size, and location (for example, urban versus rural), and characteristics of the structures in which the households live (for example, percent in apartments, percent in structures built since 1960, percent of households having vacation homes and so on). The second method of dealing with the problem is by estimating separate relationships for various functional components of household energy use. This procedure recognizes that household energy uses fall into two main classes: (1) those for which fossil fuels (coal, oil and natural gas) are often a competitive alternative (space and water heating, cooking and clothes drying) and (2) those for which fossil fuels are rarely or never competitive (air conditioning, refrigeration, lighting and small appliances).

Five separate relationships are estimated by statistical techniques, one for the "saturation" of

(i.e., fraction of households using electricity for) each of the four competitive uses (space and water heating, cooking and clothes drying) and one for "net usage" per customer, which is simply total usage per customer minus competitive usage per customer. Competitive usage per customer is the sum of each competitive saturation multiplied by its associated typical annual electricity consumption per appliance. Net usage thus includes not only non-competitive usage (air conditioning, refrigeration, lighting and small appliances) but also the deviation of competitive usage per customer from the average.

At NERA we have variously used state, county, and utility-district data to estimate the residential model. The explanatory factors included in this model in addition to the ones mentioned on page 12 are prices, both of electricity and of competing fuels, income and climate.

The results obtained to date for the competitive uses of electricity indicate that electricity and fuels prices (and availability) can markedly influence such usage over the long term. The results also indicate that the effect of future income growth on competitive electricity saturations is likely to be negligible. This is owing primarily to the fact that the total saturations for space heating, water heating and cooking--when added up over all types of energy--are very nearly 100 percent.

The results obtained to date for net usage which includes non-competitive usage (air conditioning, refrigeration, lighting and small appliances) and also the growth of usage rates on competitive appliances indicate that increases in the price of electricity could, over the long-term, lead to measurable reductions in competitive usage per customer from the levels that would otherwise have been attained. Income growth could offset this effect, since net usage appears to have at least a proportional relationship to income.

I again want to emphasize that the aforementioned price effects are long-term effects and that they could take anywhere from five to thirty years to completion. In the short-term, that is to say over a period of one or two years, the observed effect might be anywhere from 5 to 15 percent of the total long-term effect.

To estimate electricity demand relationships for industrial customers, we had to recognize the fact that industrial customers form a very heterogeneous group of electricity users, though most can be classified as part of the mining or manufacturing sector of the economy. Since different processes use electricity in different ways it is important that any analysis of industrial electricity demand give explicit consideration to industrial composition. This is particularly true where, as is often the case, regional data are used to estimate behavioral

relationships, since the mix of industry activities varies widely from region to region owing to transportation costs and the prices of productive inputs--including in some cases electricity. Specifically, electricity-intensive industries (industries with a high ratio of kilowatt-hour consumption to output) have tended to concentrate in areas where electricity rates were low. These locational decisions can easily be mistaken for energy-use decisions if not properly accounted for in a statistical analysis.

Using data for states or Standard Metropolitan Statistical Areas we have estimated demand relationships for a number of electricity-intensive manufacturing industry groups including paper, chemicals, petroleum refining, primary metals and textiles, and for a group consisting of all other manufacturing. Explanatory factors in the equations are the price of competing fuel, the price of electricity and a quantity which we call estimated demand. The latter measures the effect of an industry group's output on its demand and at the same time controls for variations among regions in the composition of each industry group. It is equal to the electricity that would be consumed in a given region if each component industry within the group consumed electricity at the same rate per unit of output as indicated by the national average for that component industry.

Our analysis indicates that electricity prices and fuel prices both have notable long-term effects on

industrial demand, although the magnitudes of these effects vary considerably from one industry to another. As in the residential sector these effects are measured against the level that demand would otherwise have grown to and do not imply that reductions in usage would actually be observed if electricity rates were increased. Rising output or competing-fuel prices could offset the effect of increased electricity prices. With respect to output, our findings indicate that electricity use is very nearly proportional to it, other things held constant.

Research into commercial energy consumption behavior both at NERA and elsewhere, has been hampered by data availability. Commercial customers, as those in the industrial sector, constitute a far more heterogeneous group than households. Apart from the size variation--compare hot dog stands to skyscrapers and shopping centers--commercial customers vary greatly in the nature of their business activities. Activities often included in the commercial sector are trade, finance, real estate, insurance, warehousing, entertainment, health care, dry cleaning, legal advice and contract construction. Unfortunately, separate data for homogeneous groups of commercial customers are fragmented and incomplete. Saturation figures are lacking and would be of limited use in any event unless they were somehow normalized for size differences among commercial firms, for example, by expressing them in terms of fractions

of total commercial floor space. Our investigations into the commercial sector have attempted to "control" for variations in commercial sector composition by including variables measuring the share of employment or output [illegible] to various components of the commercial sector in each region. Other studies published to date have virtually ignored this heterogeneity problem.

A closely related problem also given little recognition in previous studies arises from two phenomena: (1) different utilities define commercial sales differently; and (2) "commercial" customers are frequently identified on the basis of size, that is by type of rate schedule, and thus not strictly according to the nature of their business activity. If the data used to estimate commercial sector relationships are not sufficiently comparable in scope over time or across regions then the results obtained may be erroneous. Our initial work in this sector has attempted to control for these problems by restricting attention to the districts of utilities having similar definitions for commercial customers, or alternatively by subtracting manufacturing sales from total commercial and industrial sales--leaving a consistently-defined residual.

The results we have obtained to date show important effects for electricity and competing-fuel prices, the composition of activities in the commercial sector, real income, climate, and other factors.

To date I have spoken in rather general and hypothetical terms about the possible effects of electricity and fuels prices on electricity demand in the three major user sectors. I would like to be more specific about the likely trends in fuel prices and their possible effects on the growth rate of electricity demand in Montana Power's service territory.

Let me turn first to the matter of future price trends for fuels and electricity. I have made some rough calculations of possible future prices for electricity and for natural gas, the principal alternative fuel, for the Montana Power Company service territory. I estimated potential future prices for electricity in the following manner: First, I calculated the average electricity rates for 1973 for the residential, commercial, and industrial customers of Montana Power Company. According to company statistics, these were 2.45, 2.20 and 0.87 cents per kilowatt-hour respectively. I then computed the average cost of producing electricity--including the costs of owning, operating and maintaining the generating facilities, fuel costs and purchased power expenses. After adjusting for losses in the transmission and distribution system I arrived at the following estimated production costs for the three user sectors for 1973, 0.57 (residential), 0.57 (commercial), and 0.55 (industrial) cents per kilowatt-hour. I then deducted these values from the average

electricity rates for 1973 to obtain rough estimates for transmission, distribution and other costs of electric service. These are 1.88, 1.63, and 0.55 cents per kilowatt-hour respectively.

For purposes of calculating future electricity rates I assumed that the latter component of electric service costs would remain constant in real terms. By this I mean that these costs will rise at the same rate as the general level of prices over the long term. Next I estimated future values for the costs of generation on the basis of the average costs of constructing and operating a new hypothetical base-load coal-fired generating unit. After adjusting again for relative transmission and distribution losses I obtained the following estimates for the three user sectors, 1.54, 1.54, and 1.47 cents per kilowatt-hour. These costs are stated in terms of 1973 dollars and again I assumed that in money terms these costs would rise at the general inflation rate of the economy. Combining the estimated future costs of generation with the derived values for transmission, distribution and other costs given earlier, I obtained the following hypothetical future electricity rates for the three user sectors, (residential, commercial, and industrial) 3.42, 3.17, and 1.79 cents per kilowatt-hour respectively. These rates are 40, 44, and 106 percent above the average electricity rates for 1973 and would be roughly the same

percent larger than Montana Power Company's average rates as of January 1975.

If the cost increases that I have estimated took place over a ten-year period they would have the following average annual rates of growth: 3.4 for residential, 3.7 for commercial customers and 7.5 for industrial customers. These projected costs growth rates, and again I must emphasize that these costs growth rates exclude the effect of inflation generally and would be in addition to the general rate of inflation in the economy, are probably somewhat on the high side. There are two reasons for this. The costs that I have assumed for future generating capacity would--under the standard practices of ratemaking--be averaged in with the costs of generating electricity from existing facilities and therefore would only gradually make their influence felt in the total average cost figure for electricity generation. Secondly, most utilities have experienced declining real costs for the transmission and distribution components of electric service, that is to say, the nominal dollar costs per kilowatt-hour sold have in the past risen at a rate slower than the inflation rate of the economy as a whole, the result being that the real costs have gone down. I have assumed for the future that this trend would stop and that the money cost would rise at a rate equal to that of inflation.

Using Montana Power Company statistics for natural

gas costs I went through a similar procedure to calculate the possible future level of rates for natural gas sales. Starting with average revenues for 1973 of $1.024, 0.764, and 0.440 per MCF (thousand cubic feet) for the residential, commercial and industrial sectors respectively, I deducted an average cost of gas, to the company, of $0.221 per MCF resulting in estimated distribution charges of $0.803, 0.543, and 0.219 per MCF for the three major user sectors. I assumed, as in the case of electricity, that these distribution charges would remain constant in real terms in the future. I then assumed that gas at some future point would be available to the company at an average cost of $1.00 per MCF (thousand cubic feet). This figure is derived from the following assumptions concerning sources and costs: 50 percent purchased from Canada at $1.60 per MCF--the rate set for Canadian sales as of November 1, 1975--30 percent from company production in Canada at $0.10 per MCF, and 20 percent purchased from U. S. lower-48 suppliers at $0.85 per MCF. For a more pessimistic case I assumed gas would be available to the company at an average cost of $2.00 per MCF. This estimate is based upon the following figures: 17 percent purchased from Canada at $1.60 per MCF; 17 percent from company production in Canada at $0.10 per MCF; and 66 percent from U. S. lower-48 suppliers, synthetic fuel plants, Arctic sources, and non-Canadian imports of $2.60 per MCF.

Adding the distribution charge to the estimated future cost of gas I obtained the following values for future gas rates, $1.80 to 2.80, 1.54 to 2.54, 1.22 to 2.22 per MCF for the three user sectors respectively. The low end figures represent increases over the company's 1973 rates of 76, 102, and 177 percent respectively. The high cost values represent increases of 174, 233, and 404 percent respectively over the rates currently in effect. If these increases were to take effect over the ten-year period 1973 to 1983, they would imply the following average annual rates of growth for gas rates: in the low-gas-cost case, 5.8, 7.3, and 10.7 percent per year respectively; in the high-gas-cost case, 10.6, 12.8, and 15.0 percent respectively.

Given the deteriorating situation respecting the price and availability of natural gas imports from Canada, $1.00 per MCF is perhaps an optimistic estimate since by 1983 it is conceivable that a preponderance of Montana Power Company's gas would come from more expensive non-Canadian sources. The $2.00 case is more difficult to assess. It is perhaps more probable than the $1.00 case in the light of the pronouncements emanating from Canada concerning gas exports and prices and in the light of the continuing campaign for deregulation of well-head gas prices in the U. S. Moreover, it may understate the possible influence of adverse gas market conditions on future electricity demand if widespread gas curtailments

become necessary. In this event the prices that would be required to restrain demand to the curtailed levels of gas availability might be several times larger than the high cost figures that I have just given. The effective "competing fuel" might become oil. It is of course extremely doubtful that "curtailment-level" gas prices would actually come into existence. What is more likely is that some users would simply be cut off and the available supplies rationed by governmental agencies to various high-priority users. Such curtailments would probably lead to higher electricity demands than would be indicated in the results given below for the high-gas-cost case.

In the price-effect projections presented below for the residential and commercial sectors, I assume that utility gas will be available in whatever quantities demanded and take the price of utility gas service as the relevant competing-fuel price for Montana. In the industrial sector I assume the relevant competing-fuel price to be an index of prices for coal, oil and utility gas. Owing to lack of gas availability, I assume the following prices and energy consumption shares in computing the industrial fuel price index:

	1973		1983	
	Btu Share[1]	Average Price[2]	Btu Share	Average Price[2]
	(1)	(2)	(3)	(4)
Coal	.025	1.02	0.35	1.30
Utility gas	.923	0.605	0.50	1.22-2.22
Oil	.052	0.57	0.15	2.10

These figures imply competing-fuel price increases of 125 to 207 percent between 1973 and 1983.

How might these projected rate increases influence the growth of Montana Power's sales to customers in the residential sector? In the low-gas-cost case ($1.00 per MCF) the overall effect of the projected price increases would be to raise electricity demand by approximately 16 percent from the level it otherwise would have attained if prices had stayed constant (after taking out inflation). If this effect took place over a ten-year period, the average annual rate of growth of electricity demand would increase by one and one half percentage points per year over the no-price-change case. In the high-gas-cost case ($2.00 per MCF) the effect would be to raise residential electricity demand by 47 percent over the level it would otherwise have attained. Over a ten-year period this would represent more than 3.9-percent-per-year addition to the rate of growth of residential electricity demand. The cause

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[1] Based upon 1972 Census of Manufactures.

[2] $/million Btu, 1973 dollars.

of this increase would be the considerable substitution from gas to electric appliances induced by the high cost of gas.

As to the growth of demand by Montana Power's commercial customers, the estimates for the low-gas-cost case indicate that sales would be reduced by only 1 percent. If this effect occurred over a ten-year period the average annual rate of growth of commercial electricity demand would be reduced by one-tenth of a percentage point per year. The estimates for the high-gas-cost case indicate that the effect of prices on commercial electricity demand growth could be to raise electricity sales by as much as 27 percent. If the effect took place over a ten-year period the increase in the average annual rate of growth for commercial demand would be 2.4 percent per year.

To estimate the effects of projected price increases on the growth of demand by Montana Power's manufacturing customers, I assumed that the mix of manufacturing activities in the state of Montana would not change significantly over the next decade or so. In that case, the effect of energy price increases would be to lower electricity demand by 18 percent in the low-gas-cost case and by 11 percent in the high-gas-cost case--measured as above from the levels that would otherwise have been attained. If these effects took place over a ten-year period the net decline in the average annual rate of growth for manufacturing electricity demand would be 2.0 percent per

year in the low-gas-cost case and 1.2 percent per year in the high-gas-cost case. I should add that these results pertain only to the manufacturing sector and consequently exclude price effects in the mining sector for which we have not derived very satisfactory elasticity estimates. In 1973, sales to mining customers amounted to 41 percent of Montana Power Company's total industrial sales. Conservative (though somewhat uncertain) estimates for the mining sector indicate the possibility of a 22 percent reduction in electricity demand in the low-gas-cost case and a 12 percent reduction in the high-gas-cost case. Translated to 10-year average annual rates of growth these are 2.5 and 1.3 percent per year, respectively.

The projected results for the manufacturing and mining sectors indicate a tendency toward growth rate reductions, while those for the residential and commercial sectors indicate the opposite tendency. This outcome is due (a) to the greater percentage increases in electricity prices projected for the manufacturing and mining sectors and (b) to the lesser degree of fuel-to-electricity substitutability implied by our statistical estimates of price responsiveness in these two sectors.

The effect of the projected price increases on electricity demand for all customer groups taken together ranges from a 7 percent reduction in electricity demand in the low-gas-cost case to a 12 percent increase in

electricity demand in the high-gas-cost case. Based on a ten-year adjustment period, these alternatives represent a range of possible variation (about the growth rate that would otherwise have been observed) of -0.7 to +1.0 percentage points. These results are based on sales shares as of 1973. If the rates of growth of the several user sectors diverge significantly from one another for reasons other than price, then the importance that should be assigned to one sector as opposed to another could be different in the future and lead to somewhat different overall results.

EXAMINATION OF DR. KENT P. ANDERSON

Cross, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Dr. Anderson, looking at your statement, the first page, it says that you joined the Rand Corporation in 1968; is that correct?

A Yes.

Q Prior to the time you joined the Rand Corporation, had you had any experience with load forecasting for electrical energy producers?

A No.

Q Did any of your under-graduate or post-graduate training deal with the estimation of load forecasting or energy demands for electrical energy producers or consumers?

A None of my training dealt specifically with demand forecasting of electricity; some of the work I did, both as a graduate student and as an under-graduate, concerned itself with the techniques that would be used in developing forecasts.

Q You're talking in methodology as opposed to actual field work, or working actual numbers based on data dealing directly with the process of forecasting or estimating demand.

A Yes.

Q The work that you did with the Rand Corporation involving the forecasting of electrical energy demands, was that primarily for energy producers and consumers in the northwest?

A No, I should add a point of clarification here, as well; a good deal of the work was closely related to forecasting, but it did not involve directly the development of forecasts for

any particular entity. For example, a lot of the work was directed to deriving relationships that could be used for forecasting purposes without taking the next step of actually making forecasts; in some cases I did, but a lot of the work was not carried that far.

Q Sort of like practicing without plugging in the numbers?

A It was designed to develop the basic information on which one could eventually project the numbers; it was what one might consider more basic research.

Q Where did you study electrical demand in the United States?

A Once again, please?

Q Where did you study the methodology for determining electrical demand in the United States?

A I did work at the Rand Corporation related to that subject.

Q For what utilities?

A The work that I did at the Rand Corporation was, by and large, of a more general nature; I was concerned with, for example, the growth of electricity demand in the state of California as a whole. At one point, I worked on a forecasting model for the entire U.S. economy without distinguising individual utilities.

Q None of your emphasis, then, was in the northwest, the northeast, southeast, southwest, or anywhere like that?

A Save for the emphasis on California in some studies at the Rand Corportation.

Q How long were you so involved on the California study?

A The California related work embraced a period of perhaps nine months; I'm a little vague on it now, but it was about nine

months, perhaps as long as a year.

Q Was that study in relation to any particular power generating concern?

A No.

Q So, it was a general analysis more than anything else?

A Yes.

Q At the time you commenced your general study of electrical demand forecasting in California, was this your first involvement with the effects of price elasticity upon demand?

A No.

Q Was this your first involvement with the effects of price elasticity upon electrical energy demand?

A No.

Q When before had you studied the effects of price elasticity upon electrical energy demand?

A At the time that I began to do work in the energy area, my first concern was with the problem of estimating the response of electricity and other energy demands to price; the first application happened to be in the primary metals industry. Later I did related work for the residential sector, and later still, for the -- actually since leaving Rand -- for all sectors.

Q Even at that time, when you were working for Rand, you concluded, did you not, that the response to changes in price between the residential sector and the industrial sector is different?

A Yes.

Q Which is more volatile?

A I am not sure what you mean by volatile.

Q Which generally reacts more in terms of demand as a result of the price increase?

A Let me try to answer that question by going a little bit into detail. In the work that I have done, both in the residential sector and in the industrial sector, I have gone into a number of the components that make up total demand in each of those sectors. For example, in the industrial sector, I have estimated relationships for a number of different manufacturing industries; similarly, I have estimated relationships for the demands for various types of residential appliances. The degree of responsiveness in each of these cases varies from one to another. There are some industries in which price response is relatively low, some industries in which it is relatively high. The degree of price responsiveness in the residential sector also varies depending upon the component of demand to which one is referring; they generally overlap in responsiveness, that is to say there is no great order of magnitude difference in the long term responses to price that I have estimated, as between the residential and the industrial sectors.

Q In your study that you did in evaluating the electric energy policy in California, did you make any recommendations to legislative committees?

A We did not proceed to the point of making what I would call recommendations; at the end of the study we listed a number of policy actions that we felt should be given consideration by the legislature. They were, really, less to be viewed as

recommendations, and more to be viewed as alternatives for consideration.

Q Could you equate that with the intent to control demand by legislative action?

A I'm sorry I missed the first part of the question.

Q Could you interpret that as guidance to the legislative committee to control demand by way of legislative action?

A Among the suggestions that we offered as possibilities for consideration were steps that could be taken by the legislature to control demand directly.

Q You listed about 12 steps, didn't you?

A I don't remember how many there were to tell you the truth; I couldn't even recount them all.

Q Can you recall any of the recommendations that you made, or not recommendations, but findings, or whatever you want to call them?

A Alternatives for consideration.

Q Fine.

Q They included measures that might be called incentive type measures, taxes, for example, on electricity sales. They also included prescriptive measures such as labeling of appliances to indicate their efficiency, changes in building codes to require improved insulation. They also included job owning type policies, or public information type programs that would provide information to electricity users about waste which they might conserve on electrical energy. Those, perhaps, give you a brief sampling of the kinds of recommendations, or excuse me, not recommendations but suggestions that

were included in the list.

Q Did you, in your relationship with Montana Power Company, conduct any surveys to determine the extent of measures taken by power companies to reduce electrical demand?

A No.

Q Did you take any action to survey what activities had been undertaken by the other participants to the proposed Colstrip project to reduce electrical demand?

A No, I did not.

Q Prior to your employment as a consultant to the power company, had you done any work which enabled you to evaluate or learn of the methodology used by the other participants to the Colstrip project?

A Yes, in connection with work that I was doing for the Pacific Northwest Utilities Conference Committee involved in part the surveying techniques being used for load forecasting purposes by a number of the utilities in that organization.

Q Other than your survey, though, of the techniques used by the utilities for load forecasting purposes, did you make any attempt to survey the actions by the participatory members to the Colstrip project to reduce energy or electrical demand?

A No.

Q And you have not done so up to now, have you?

A No, that is correct.

Q In your statement of testimony, on page 2 you make reference at the beginning of line 4 to the coordination and writing of a forthcoming technical advisory report to the Federal Power Commission, is that correct?

A Yes.

Q What is the name of the committee?

A The name of the committee is the Technical Advisory Committee on the Impact of Inadequate Electric Power Supply.

Q Who is the chairman of that committee?

A The chairman of that committee is Dr. Erwin Stultzer.

Q Do you know him from any working relationship?

A Yes, he is the president of the company that I work for.

Q Is he your supervisor?

A The organization of the company is such that I don't really have a formal supervisor. Much of the quality control, if you will, that applies to the work that we do takes place in the form of what I might call peer group analysis or criticism; but insofar as I do have a supervisor, I guess you could say that he is it.

Q As chairman of that committee, does he have responsibility for drafting any portions of the report?

A He has the responsibility of seeing that a drafting of the report occurs, although he doesn't necessarily bear any responsibility to write any part of it at all; he has, in fact, contributed parts to the report, however.

Q I take it that most of his contributions have been in coincidence with the views that you expressed?

A Yes.

Q Dropping down, now, to your statement beginning on line 18 of page 2, you say that most utilities today place a heavy reliance upon trend extrapolation to project loads. Do you consider that the most valid way to project loads?

A I don't think there is a single way that could be identified as the most valid way. There are a number of ways one could go, I suppose, in developing a forecast. In retrospect, I suppose the most valid one was the one that was closest to the truth; beforehand, it is difficult to say which forecast that would be.

Q Were you here when the representatives of the other participants to the Colstrip project testified last week?

A No, I was not.

Q You recognize, and I assume will concede, that the methodology used by the five participants are not in coincidence for purposes of load forecasting?

A I have not examined carefully the individual methodologies of each of the five companies for purposes of determining whether they are mutually consistent in assumption of approach. My principal concern, in connection with this testimony, has been to take an independent look at the role of price, really quite a part of what the individual utilities have been doing.

Q You are sufficiently aware, however, that the five companies participating in the Colstrip development do change the various variables available to them for purposes of determining load?

A I'm sorry, could you go over that once again, please?

Q Yes. You are aware, are you not, that the five participants to the Colstrip project do use different variables for purposes of determining a load?

A I would assume that to be the case; it has been awhile since I've looked at the forecasting methodologies of the individual companies; but I would be surprised if they were absolutely

identical all the way along the line. Each individual forecast or each individual company will almost inevitably pursue a slightly different path from that of any other; that would be true, I might add, regardless of the kind of methodologies that were involved. It is also true that just about any econometric forecaster develops his forecasts a little bit differently from every other.

Q In order to make it fit the risk?

A Well, we all look at things from a slightly different point of view, and it would be the remotest coincidence if we put them together exactly the same way; in fact, we would be in trouble if we did, I suspect.

Q In your consulting efforts on behalf of the power company, have you had occasion to discuss load forecasting with Bernie Goldhammer, formerly of the Bonneville Power Administration?

A No.

Q In your consulting efforts for the Northwest Coordinating Council, have you done work for the preparation of the West Group Forecast?

A Do you mean for the PNUCC, the Pacific Northwest Utilities Conference Committee?

Q Yes.

A I have done work that heretofore has not impinged at all on the West Group Forecast, but which may in the future; in particular, I have been in the process of developing an econometric forecasting model for the PNUCC which it may use in the future in developing forecasts for the West Group.

Q You are aware, are you not, that the West Group Forecast for

1976 is due to be released within the next month?

A Yes.

Q Have you learned yet that that forecast is going to show a sharply reduced load from previous projections?

A I had heard that, that it would be down from the last year's projection.

Q Are you familiar with the order of magnitude of that reduction?

A No, I am not.

Q Have you discussed the projected reduction in load to be released in the West Group Forecast with anyone from the Montana Power Company, other than the attorneys for the company?

A No, as a matter of fact, I have not discussed the forthcoming West Group Forecast with anyone. I actually have no knowledge of what went into the forthcoming West Group Forecast or what it will say.

Q Turning to page 3 of your statement and commencing on line 11, you make comments regarding the separation of historical loads or consumption in the weather sensitive and base or normalized components. What did you do on behalf of the Montana Power Company in that regard?

A The breakdown that I used for purposes of analyzing the effect of price was based on an identification of the users by economic sector, so I did not follow this type of breakdown. Rather, I broke energy demand down into the familiar residential, commercial, manufacturing and mining categories?

Q Without accommodation to weather sensitive components?

A That is correct; the analysis that I did could be interpreted

as pertaining to normal weather year conditions. I made no investigation of the role of vagaries in weather upon any demand in any given year.

Q What demographic studies did you conduct on behalf of Montana Power Company?

A I did not conduct any demographic studies directly for Montana Power Company. A number of the price elasticity relationships that I used to analyze Montana Power Company's demand were based upon statistical studies that included demographic variables as part of the models; so, indirectly, demographic factors came into the picture that way, although, as I say, there was no direct investigation of -- there was no need, in fact, to perform any direct investigation.

Q Certainly then, it's fair to say that insofar as the demographic studies conducted by others in determining the various components over the Montana Power Company load forecasts, you made no independent effort to determine their validity?

A That is correct. You must remember that my principal concern was not to develop a load forecast for Montana Power Company, but simply to determine how prices might cause the trend rate of growth either to be greater or lesser than it otherwise would have been; so, I did not attempt to locate, particularly, where the base line would be, but rather to examine what the variation around the base line could be as a result of price effects.

Q Well, whatever the base line would be for purposes of determining or estimating what the variation would be still requires some consideration be given to the validity of the base

line, does it not?

A Yes, it does, if one is to take the step of asking whether the base line is correct.

Q Did you do that?

A No, I did not.

Q In developing your forecasting model, you did, of course, give reliance to the primary sectors which comprise the Montana Power Company's power using customers, did you not?

A Yes.

Q And that was residential, industrial --

A Commercial.

Q And commercial. Did you make any contact yourself with any of the commercial customers of the Montana Power Company to determine whether or not the projections for industrial usage were reliable?

A No, I did not.

Q Your earlier study of price elasticity and the effects of a change in price in the industrial sector really did not allow you to reach definitive conclusions, did it?

A That was the 1971 study of primary metals; yes, that is correct. That is not the study upon which these estimates are based.

Q I am aware of that, but the question was --

A Right.

Q Okay. On the first line of page 4 of your statement, you round out a general statement regarding the effects of future energy price changes by saying that company forecasts generally are on the basis of informal analysis. Why do you use the

terminology informal analysis there?

A By that I mean to distinguish the sort of analysis that is done in this case with that of building explicit quantitative mathematical models that translate precise assumptions about numbers into precise results.

Q The informal analysis is one of studying the historical experience?

A Instead of having an explicit mathematical model in front of you which you try to estimate somehow, by looking at data or whatever, you have, instead, a model in your head which may be simpler or it may be more complex than the model that you can put down on paper; but that is really what I had in mind, the difference between a mental model and one that you can write out, step by step, on a piece of paper.

Q And the mental model or the one you write out on a piece of paper, though, is to be challenged by what, history?

A History or the future as it unfolds.

Q The model which you developed for the Montana Power Company was first worked on by you when?

A Let me first say that it might be misleading to refer to what I have done as a model, because I have not developed what you would call a complete set of forecasting relationships that would yield a projected level of demand for the company. Rather, I have applied a number of equations relating to price response to the demands of the company to estimate the influence of price on demands; I haven't really developed a forecasting model. In a sense I've developed a model; I've developed a model for predicting the influence of price changes, if it be

understood that that's what the model refers to rather than to a full-fledged forecasting model.

Q I see. The model that you developed, then, is not really tested by time in terms of forecasting.

A No, it certainly has not been tested by time.

Q Turning to page 5 of your statement, you address yourself to the two weaknesses of the trend extrapolation approach. First of all, let's define for the record what you mean by trend extrapolation approach?

A The trend extrapolation approach is that of assuming that an historical trend observed over some time period will continue to prevail over some future time period.

Q Does that type approach allow for exponential growth in trend forecasting?

A It does if -- the problem is this; there are different kinds of trends that one can look for, or there are different kinds of assumptions that one can bring to bear in making trend analyses. One can assume that the trend is linear and project a linear trend, or one can assume that the trend is exponential and project an exponential trend. What type of trend one ought to project depends heavily upon what else you know about the factors that influence that trend, what you believe the underlying growth mechanism to be. If it's a trend, for example, that's influenced greatly by economic growth, and economic growth has exhibited an exponential trend, then, perhaps it would be reasonable to assume that an exponential trend would be the right one to use under the circumstance; it depends on the case at hand.

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Q Did you make any determination in your studies in the Montana Power Company service area to determine whether or not the trend approach used there allowed for exponential growth?

A No, I did not, not for purposes of this testimony.

Q When were you first contacted by the Montana Power Company?

A I will have to give you a rough date because I am not quite sure, perhaps Mr. Bellingham can correct me if I'm wrong; but I believe it was about a year ago, January of last year.

Q January 1975?

A Right.

Q Your first contact was from Mr. Bellingham?

A Yes.

Q Prior to the time Mr. Bellingham contacted you, had you had any discussions with representatives of the Montana Power Company concerning their load forecasting?

A No.

Q Subsequent to the time you were contacted by Mr. Bellingham, with whom from the power company have you received information, other than the attorneys?

A By phone I've spoken to two or three fellows, and, unfortunately, it's been a long time since we talked and I don't remember their names.

Q Have you ever gone to Butte to talk with the people at their headquarters?

A No, unfortunately I haven't had the privilege of visiting Butte yet. I understand my return flight takes me through there, so if it's a clear day I'll get a view.

Q Now the approach that you take, or are advocating, essentially,

is what you call the behavioral approach, correct?

A That is the approach that we have used at NERA, and which I personally have used in developing forecasting models and, also, in analyzing the effect of prices for the power company.

Q How do you compensate for the effects of exponential growth upon behavioral analysis?

A The structure of the behavioral model will determine whether growth is exponential, I should add that the structure of the behavioral model plus the assumptions that you make about the driving variables that go into the structural model. What it boils down to is that you have, say, for a particular type of use, or for the saturation of a particular appliance, you have an equation; the growth of the saturation variable, or the growth of demand in that particular category, may or may not be exponential depending upon the characteristics of that equation and the growth that you project for the variables that go into that equation, or the explanatory variables in that equation.

Q Have you ever used the model that you're applying to the Montana situation anywhere else?

A The price components of the models that I have used for forecasting purposes elsewhere are the price components that I used to calculate the effects of prices on Montana Power Company's demand growth.

Q Where else did you apply this model?

A I have applied models of this sort in work that I've done for the Pacific Northwest Utilities Conference Committee, in connection with West Group sales growth; I have used these rela-

tionships in models for Puget Power, and for a number of utilities in the southwest, including El Paso Electric Company, Public Service Company of New Mexico, a Salt River Project, Arizona Public Service Company, and Southern California Edison Company.

Q Now you said variations of this model; I take it it's not the same model?

A No, the models differ in various ways that reflect the differing conditions in each of these areas.

Q You will agree that the behavioral approach can be either aggravated or minimized, insofar as the consumer is concerned, based upon that individual's income?

A I'm sorry, are you drawing a connection between consumer income and the behavioral approach as a methodology?

Q Right.

A I'm sorry, I'm not getting the connection perhaps.

Q There is no connection, is that right?

A I can't answer that one because I'm not sure I understand the question that you're asking.

Q Well, in your behavioral analysis, do you account for the income of the consumers in the service area?

A Oh, do we, yes.

Q Do you know what the average income of a wage earner in the State of Montana is?

A Actually, I don't have the information with me; I have it in connection with the model that I have been working on, but I don't have that information handy here; I don't know what it is off the top of my head.

Q Off the top of your head, can you recall whether any of the other areas in which you applied similar models had average wages similar to, or very close to, those of the average wage earner in Montana?

A Not having the exact figure, or not having the figure for wage earners in Montana, I couldn't give you an exact answer; but I would be surprised if there was a great difference; there would be some difference from state to state, of course.

Q It is a fair assumption, isn't it, that if a person is making $10,000 and the price of electricity goes up, he is going to cut back more than a man who makes $30,000?

A That may be the case, it certainly is a plausible hypothesis; I might say, however, that most of the econometric models that have been developed to date have not been sufficiently refined always to measure these kinds of interactive effects. For example, many models that have been developed assume constant price elasticities for all income groups, although the models that I have used in the residential sector don't. I don't think there has been any model to date developed by anyone, me included, that has been able to extract from statistical information confirmation of the relationship that you describe, although it may well exist. I think the problem is more with the primitive state of modeling than it is a problem of the hypothesis not being verifiable.

Q You will agree, then, that it's probable that a man who has his electricity bill double making $10,000 a year is going to turn his thermostat down to 68 more rapidly than a man making $30,000 a year?

A Well, it depends, partly, on what you assume about everything else. What I mean is, for example, what happens if the poor, or the lower income individual, happens to like a warm house much more than the more wealthy individual who, perhaps, may not mind living in a cooler environment? What I am saying is that there may be off-setting factors, or it may be also true that one guy has a relatively efficient heating system and the other guy has a relatively inefficient one. If the lower income guy has been very careful and very economical and, thus in a very efficient system, he may be able to continue to use a fair amount without suffering too much of a penalty; whereas, if the other guy has a very inefficient system, he may feel a greater need to cut back. It is difficult to generalize; there are other factors that play a role. If you would allow me to say that everything else held the same, or balancing things out so that the guys have equal preferences, and they have equally efficient systems in their households and so on, I would agree with you that that would seem to be what one would expect.

Q That's one of the things that you do when you want to make nice curves of supply and demand is hold other things equal, isn't it?

A Well, actually, what you try to do is incorporate as many of those varying factors as you can in your statistical analysis; you try to account for differences between high income households and low income, between large and small, between urban and rural, and so on. If you are successful, you capture the influence within your model of these various factors. I think

it's fair to say that we have had some limited success in this area; I think that there is still every reason to believe that we've missed things and that our estimates are still crude, but at least we have made some first steps in trying to incorporate those factors into our analyses.

Q You make a statement commencing at line 14 on page 6 of your statement talking about one of the consequences of the behavioral approach and addressing the question of apparent uncertainty in the forecast. Are you saying there that the uncertainty is greater with the behavioral approach when you insert what if's?

A The uncertainty is what it is, in a sense; but it may look like there is more uncertainty when you use this approach because almost invariably you are generating alternative forecasts; so, rather than looking at a single number as your end result, you end up with an array of numbers, so you are forced then to go through another step and ask yourself, "Well, out of this array of numbers, what seems to be the most probable one, or the one that we should use for planning purposes."

Q In making the determinations of what some of the more probable numbers should be, did you have the advantage of consulting with other people who had attempted to determine models of a similar nature to yours for the State of Montana?

A I didn't discuss any other models for the State of Montana with anyone. Of course, I did consult the published literature, and some unpublished literature, on the methodology and application of forecasting in this area in doing this work, but I did not specifically talk to anyone about Montana.

Q Are you familiar with the work of Dr. Duane Chapman on price elasticity?
A Yes, I am.
Q Did you discuss this with him?
A I discussed his work at an early stage, but I have not discussed it personally with him since the time that he published it.
Q Have you published any written reports which have appeared in professional journals which discuss or address the methodology used by you which is specific to the model that you are trying to develop for the Montana Power Company?
A None of the research that I have done in the last year or so in connection with Montana Power Company or with other companies has been published.
Q Looking at the last paragraph on page six of your statement, you discuss certain risks of over-estimating load. Where in your experience have you had an opportunity to measure the actual monetary effects upon consumers in a service area for a utility who are victims of expansion beyond demand?
A Would you care to identify such an area; is there any such area?
Q Have you ever been involved in the study of any such area?
A I am not aware of any area where that fact has been established; there may be; if so, I don't know, and it also follows that I have not done any such study. My analysis is based on general considerations rather than on any specific case studies.
Q In other words, no?

A I think the answer stands as made.
Q In substance, no?
A Could you repeat the question?
Q Certainly; I'll ask you if you have ever had the opportunity to study what the effects would be in actual monetary terms upon consumers in a service area that has expanded beyond demand?
A I have studied it in general terms, but not in reference to any specific case situation, if you will.
Q On page 8 of your statement, line 16, you make the statement, "The practice of forecasting peak load on the basis of sales figures, of course, presents no major problem as long as customer load factors are stable, or trends in the load factors can be predicted with a reasonable degree of certainty." Do you consider that the past West Group Forecasts have been predicted with a reasonable degree of certainty?
A Excuse me; I would be happy to answer the question; let me just check one thing; I read accuracy on the end of that statement.
Q Fine, sir.
A Do I believe that the West Group Forecasts have been made with a reasonable degree of accuracy?
Q Yes.
A My impression is that, by and large, they have been pretty good.
Q What is good, then, in your impression?
A I guess good is -- what I mean is that a forecast which, for planning purposes, puts the system into a position of not

overburdening its customers with a lot of excess capacity, and not penalizing them with too little capacity. In other words, if the planning based on the forecast puts the company into a reasonably viable situation over the years, and puts it into a position where it's not penalizing the customers one way or the other, then I would say they have done a pretty good job of forecasting.

Q Have you made any historical analysis of the West Group Forecasts in the past five years?

A I've given, really, very little attention to the relationship between the forecast and the actual outcome over the last few years?

Q You're aware that in Agust of 1975, the estimated load for the Bonneville Power Administration was 22 percent below -- or the actual load was 22 percent below the estimated load?

A You have to remember that a forecast is a long-term forecast, as a rule, and that these forecasts assume that the economy is going to be operating at a fairly normal level. In any given year or two, if the economy goes through a recession, the forecast won't reflect that; it's not intended to reflect that. A reasonable long-term forecast, I think, has to be based on the assumption of relatively normal economic conditions; it's not intended to track year to year fluctuations due to ups and downs in the economy. Now it's quite clear that the economy has been down over the last year and a half, and that that would be reflected in a situation where the long-term forecasts were well above what actually happened; that happens anytime there is a fluctuation in the economy, and it's not really, in

my opinion, an adverse reflection on the quality of the long-term forecast; what it reflects is what has been known all along, but it's a long-term forecast not a short-term forecast.

Q Did you know that Bonneville Power Administration estimates one month in advance also, in addition to its long-term forecast?

A I'm not aware of the specific operating procedures that they go through on a short-term basis.

Q Did you make any analysis of the actual versus estimated loads of the service area for the Montana Power Company in the past five years?

A No.

Q Turning to page 13 of your statement, line 12, you make the statement, "At NERA, we have variously used state, county, and utility district data to estimate the residential model." Now NERA is your present employer, correct?

A Yes.

Q When you were at NERA and were a consultant to Montana Power Company, did you make any contact with the Energy Planning Division of the Department of Natural Resources and Conservation for the State of Montana?

A No.

Q Now you are using two terms here, price elasticity and cross elasticity. Cross elasticity, as I understand it in your definition, is what happens to the demand for electricity assuming a change in price in other fuels; am I right?

A Yes.

Q Did you make an analysis over the past five years of the price changes in alternate fuels for the State of Montana, or the Montana Power Company's service area?

A The approach that I took was to project price changes in Montana for competing fuels in the future, or from 1973 to 1983, and apply those price changes to statistical models that had been estimated for various regions of the country.

Q From whom did you obtain your price information for the projections for natural gas?

A The price information is based partly on information from Montana Power Company, and partly on information available -- public information collected by Montana Power Company and passed on to me, and partly from general information that I have about prices, generally, energy prices generally.

Q Did you contact anyone from the State of Montana regarding prices?

A No, I did not.

Q With whom from the Montana Power Company did you obtain this data?

A I don't remember now exactly who gave it to me, whether I asked John Ross or somebody else to get it for me; at more than one point I was directly in contact with a couple of the fellows there, and I am embarrassed that I don't remember their names, I must say.

Q Turning to page 15, commencing on line 4, you make the statement, specifically, "Electricity intensive industries, industries with a high ratio of kilowatt hour consumption to output have tended to concentrate in areas where electricity

rates were low." By electricity intensive industries, I assume you're talking about primary metals industries?

A That would be a good example.

Q Aluminum?

A Right.

Q Are you aware of the concentration of aluminum producers in the Pacific Northwest as compared to the total number of aluminum producers in the United States?

A Yes.

Q It's approximately 1/3 of the aluminum reduction plants in the northwest; isn't that right?

A I don't know what the exact proportion is, but I'm sure it's quite high.

Q It's 12 out of 34, isn't it?

A As I say, I don't know what the exact numbers are, but I'm aware that the Pacific Northwest is an area of great concentration of aluminum production.

Q Do you know what rates are paid by those aluminum producers?

A I can't remember the exact numbers; I know they are quite low.

Q About 20 percent of the residential rate, isn't that right?

A Well, I think it's on the order of a few mills a kilowatt hour, two or three, I think; I really don't remember the exact number, that's why I hesitate to provide a figure which could be wrong.

Q Have you ever been made aware of the percent of electrical energy sales by the Bonneville Power Administration that go to the aluminum industry?

A Again, I can't provide you with the exact number; I know it's

a large percentage.

Q Like 40 percent on the average, isn't it?

A I'm sorry?

Q About 40 percent of BPA sales go to the aluminum industry?

A Forty percent of BPA sales?

Q Yes, is that about right?

A As I say, I am not aware of the exact number; I will take your word for it.

Q It varies from year to year; I won't represent that as a constant in each year. In you consultative efforts for the Pacific Northwest Utilities Conference Coordinating Committee, have you ever discussed with them any concerns they may have with respect to actions of the Bonneville Power Administration in its sales programs to energy intensive industries?

A No.

Q Have you discussed with any of the five members of the consortium on the Colstrip project, any involvement they may have with private funding for aluminum industries in the northwest?

A No.

Q Have you ever seen the report prepared by Arthur D. Little on the electro-metal industries in the Pacific Northwest?

A No, I have not.

Q You make the comment on page 16 commencing line 11 that NERA, as others, has been somewhat hampered by the availability of data for purposes of commercial energy consumption behavior analysis. Did you have that trouble in Montana?

A Yes, the data that we have used in these studies are normally data for groupings of regions; for example, states, and

Montana has been, of course, one of the states that has been included in the data sample; so the problem as associated with getting the data for the other states also was encountered in the case of Montana.

Q Specifically, what type problems do you have?

A Well, I think the two biggest ones are pointed out in the testimony; first, the data available on energy sales, electricity and fuels, to commercial customers are not consistently defined from one region to another; and if differences from one region to another are to be explained, by differences in prices from one region to another or differences in income and so on, it's necessary that the same thing be compared from one area to another. So, there is the problem of getting a consistently defined total of consumption for each of the areas that is included in the statistical study. The second problem that we had to deal with was that commercial users, as a class, are a heterogeneous, a very mixed bag of customers; they can include small restaurants, large warehouses, and various other things in between; and, in fact, more than that, we found that because of the difficulties in getting good statistical data, many commercial sector figures include usage by sectors that wouldn't be thought of as commercial at all, things like construction or communications. So, in developing estimates for the commercial sector, I try to include as explanatory factors in the relationships that I estimate some variables that measure the mix of commercial sector activities in each region, so that if one region had a lot of communications or transportation type customers, that

would be reflected in the equation and would, to some extent, be accounted for. So, those were the two major problems that I had to deal with in the commercial sector.

Q In addressing the second problem to determine the measure of the mix of variables, did you go out and do any field work yourself?

A The procedure that I took was to obtain data from published sources on the mix of economic activities in each of the regions, and then introduce these statistical data into the analysis. It wasn't necessary to go out, say to the published data sources, for these numbers.

Q You say it was not necessary to go out to the published data sources?

A It was necessary to go, but the only thing that we had to do was get the published data sources to take care of this problem; it was a matter of utilizing data that were available that just hadn't been utilized before in this area.

Q What data did you go to in your analysis of the commercial sector for this particular company?

A We relied upon data published by the Department of Commerce on personal earnings by sector of origin.

Q What years?

A The commercial study that -- well, there have been a number of different commercial studies done; the ones that I have done have focused on 1971 and 1962, because these are two years for which the requisite data are available from the published sources; those are years in which the census of manufacturers, for example, has been collected. The information

collected from those censuses is required and is published only for those years, unfortunately; so, we had to restrict our data analysis to a limited number of years. We would like to do more, but it's just not possible at this point.

Q So the last year was 1971, right?

A Right.

Q And nothing was supplemented by the Montana Power Company in that sector, was it?

A Nothing was supplemented by Montana Power Company?

Q Beyond 1971?

A No, it wouldn't have been sufficient. The problem is that the statistical analysis depends upon being able to compare conditions across a wide array of regions. The idea is that we learn how to explain demand in one region as a function of its conditions by comparing how demand varies across regions as a function of changes in those conditions across regions; so, it wouldn't be sufficient just to get data for Montana; it would be necessary to obtain data for a broad array of regions for the 50 states, for example, or for the 48 states.

Q Are you aware of any methods the Montana Power Company uses to determine the mix in the commercial sector of their customers?

A It is my understanding that the demand forecast for Montana Power Company is broken into two major components, the block component consisting of large industrial customers, of which now there, apparently, is only one; and -- a block and a base, I think that those are the two words -- a base component, which is extrapolated. The extrapolation, then, is adjusted on the

basis of a number of pieces of information through an informal judgmental process, and I would assume that part of that informal judgmental process involves getting some information from commercial customers; but precisely what customers the company would interview, or what kinds of information they would bring to bear, I don't know.

Q You didn't address yourself to that anyway?

A No, I did not.

Q And you didn't rely upon that information in any way for your purposes?

A That is correct.

Q You say they only have one large industrial customer now?

A In the block component, that was my understanding.

Q Who'd they use?

A I don't know; I guess it was a mining enterprise of some kind.

Q In any event, would that have any effect upon your model?

A Yes, it could. I have done a separate analysis of price effects, sector by sector, of which the mining sector is one; when I add up the effect of prices across all the sectors to get a rough total for total energy use, I assign certain weights to the various sectors. Now the weight that I used in my analysis for mining was the share of total sales to mining in 1973. Now it may be that that share has gone down a little bit because of this; so I should be assigning less weight to the influence of price in mining, the mining sector, and more weight to the influence of price in the other sectors.

Q You do not have the knowledge at this time of the extent of the block sale loss in the mining sector which has occurred

subsequent to the time you formulated your model?

A That is correct.

HEARINGS EXAMINER: Would this be a convenient time for a recess? We will recess for ten minutes.

RECESS AT 3:00 P.M.)

The hearing was reconvened at 3:20 P.M., following a brief recess.

HEARING EXAMINER: You may proceed, Mr. Sheridan.

CONTINUATION OF EXAMINATION OF DR. KENT P. ANDERSON

Cross, by Department of Natural Resources and Conservation

By Mr. Sheridan (continuing):

Q Dr. Anderson, on page 18 of your statement, line 9, you made some rough calculations of possible future prices for electricity and natural gas. I take it the information on future prices for natural gas you received insofar as the Montana Power Company service area was concerned, was from the Montana Power Company?

A Well, I obtained the historical cost data from the Montana Power Company. The estimates for future costs were based mainly upon my judgment, and not upon any set of figures that the company provided me.

Q You say you relied upon your own judgment for the projection of future price increases for natural gas, right?

A Yes.

Q What studies have you done with respect to historical price projections for natural gas prior to your consultation for the Montana Power Company?

A During my last year of work at the Rand Corporation, I participated in a study which examined the long-run marginal costs of producing various forms of energy, including gas, and also, I, during that year, constructed an energy demand supply forecasting model for the United States that projected

market prices for, among other things, gas, over the period 1973 to 1994 or so.

Q You did not, however, did you, take into account the areas other than the Montana service area, for purposes of projecting possible future price increases for natural gas within the service area?

A As part of my judgment about the possible level of average gas costs in the future, I considered what the prices were that were being paid currently in the intrastate gas market, for example.

Q Interstate or intrastate?

A Intrastate -- and relied on information about energy markets outside the State of Montana as much as inside the State of Montana.

Q Are you aware of the production potential for natural gas in the State of Montana by subsidiaries of Montana Power Company?

A I do remember reading some figures. My general impression is that the capacity for -- the potential for natural gas production in the State of Montana in the future is not great and that sources outside Montana must be looked to, primarily, to provide the bulk of future gas supplies.

Q You're aware of the natural gas holdings that Montana Power Company presently possesses?

A The natural gas quantities?

Q Yes.

A I really don't know what the specific reserve quantities are at this point. I know that most of the gas comes down from Canada. I think it was about 84% in 1973, down a little bit

in 1974, perhaps, to perhaps 75%. As far as I know, the rest comes from Montana.

Q And do you know whether that gas that is brought down from Montana is used in Montana or shipped further east or west by Montana Power Company?

A The quantities that I was referring to were the quantities sold to customers in Montana. I don't know about any shipments that would go out of the state.

Q You're aware, however, that there is a wide diversion in rates for natural gas, depending upon whether or not it involves intrastate sales or interstate sales?

A Yes.

Q Can you give me some estimate of your understanding of the magnitude of the difference between the intrastate and interstate sales?

A Well, let's see. Recent contracts during the last year for intrastate gas signed in the United States averaged, I think, around $1.20 Mcf, although there was considerable dispersion. Some contracts were well below that, some well above. What the current interstate wellhead price is for new gas, I'm not sure at this point. I think it's around 50 cents or so, so those numbers could be off a little bit, but that's a rough picture of the way things are now, I think, about 50 cents for interstate gas, new contracts, and about $1.20 on the average, for intrastate.

Q It's fair to say the consumption being the same by a particular customer, a price increase for the intrastate gas would be higher and would have more effect than an interstate sale?

A Well, let's see -- the problem that I'm having is trying to set up a mental experiment that will permit me to answer the question. If I understand your question correctly, you're asking me the following: if a user had been using gas that had been provided through the interstate system at a cost of 50 cents, experienced an increase in the price of his gas of, say, 50 cents, as compared with a user who had been paying $1.20 and experienced a 50 cent increase, that the first user would respond more vigorously, say, than the second user -- is that the question?

Q Yes.

A He might or he might not. That's a typical economist's answer, I guess, but the reason is the following: while the percentage increase is bigger for the first guy, his price is being, say, doubled, it may be that in the case of the second guy, that fifty cents is the straw that breaks the camel's back; in other words, the first guy may still feel that a dollar gas is still a bargain and that he can afford to pay it. The other guy may feel, "By Jove, that last fifty cents drove me over the top, and I've got to do something about it," so you can't be sure that it's going to work that way.

Q You don't have a model for that?

A The models that I used for the commercial and industrial sector assumed that the effect is going to be the same for either guy, for the same percentage increase; in other words, if you increase anybody 50%, he's going to respond the same way, so that in the kind of model that I've developed for the commercial and industrial sector, the guy who had been paying 50

cents and got raised to a buck would respond percentage-wise more than the guy who had been paying a buck fifty and got raised to two. Now, whether that's an accurate reading of reality still remains to be tested, quite frankly, and the reason that we have that kind of model is because it's been, so far, about the best we could do. In the residential sector, it's a little different. We've been able to refine our approach a little bit and we have models that vary the price elasticity, depending upon where the user is -- that's a little vague, but perhaps I can give you an example that will illustrate what I mean. In the residential models, in particular, the saturation models, the effect of a price change will depend upon the levels of saturation that already exist in the market place. For example, if the market is heavily saturated with gas-using equipment, say gas heating, a reduction in the price of gas won't make much change -- will not bring about much of a price change. An increase in the price of gas, at first, won't bring about much of a change, either, because you have to get to that kind of straw breaking the camel's back situation, but then, after a while, if you keep raising the price of gas, then the price effect gets pretty strong and you get a lot of conversions to electricity and you get a higher elasticity, but then, if you keep raising the price even more, you've finally used up, if you will, or provided enough incentive for practically everybody to switch over so there aren't that many to switch over any more, and again, the price elasticity, the cross-elasticity, if you will, of the price of gas, begins to go down again, as you

exhaust the possibility for substituting gas for electricity, so we have this kind of variable price elasticity response that's tied to the current situation and the market place. That's, I think, a desirable refinement.

The work that I did, as I say, for the Montana Power Company, for the commercial and industrial sector, does not have that refinement, so I might add that in later work that I have done, I have adopted models of that kind, or tested tried models of that kind, as well as of the type that I used here, and there are some differences in the results, although really, it turns out that the differences aren't too radical.

Q One substantial difference between the residential sector, on the one hand, and the commercial and industrial sector, on the other, is the fact that the commercial and the industrial sector have the inherent capacity to pass that increase on to the customer, isn't that true?

A Only within limits, because -- well, primarily because that will, of course, add to their costs and perhaps reduce the -- that, maybe, is only one small element, but that, added to everything else, will help to increase their costs, which I'm sure they're reluctant to do. Also, they may face competitors who are in a better situation because they have anticipated the change and so may be reluctant to raise their prices any further because their competitors won't be doing so or because they fear they won't be doing so, but it's quite possible that they could. That still does not mean, presumably, that they wouldn't want to minimize their costs, whatever they were, and therefore, if it were economic to do so, make

substitutions of one fuel for the other when the old equipment ran out or when designing a new plant or whatever, so while they may or may not pass along the cost increases, it still should remain true, if they are interested in operating efficiently and maximizing their profits that they would respond as they would be expected to.

Q It makes good business sense, good economic sense, if you're in business for a profit, to pass those cost increases on to purchasers?

A It makes good business sense to pass them on if you can't do anything to cut them. Now if, for example, the price of gas goes up very high and you can save by making some change in the way you use gas, or eliminating it in some way, then presumably you'll do it rather than simply pass the costs along, because that will put you at a competitive disadvantage.

Q Insofar as electricity is concerned, however, assuming your competitors are also in your service area, they, too, are going to be in the same boat as you insofar as increased costs, isn't that true?

A It's true, but what if your competitor is interested in minimizing his costs so as to have the most competitive price, you, too, then, are compelled to minimize your costs, which means doing whatever is economically feasible to keep costs down, making whatever substitutions or taking whatever conservation steps you can consistent with the economics thereof.

Q Well, consistent with the economics of a raise in the price of gas or energy, the commercial user and the industrial user certainly has the ability to pass on price increases to varying

degrees, whereas the residential user cannot pass on price increases, isn't that true?

A Well, that's true because the residential customer is not in business to sell a product. He can pass on a price increase in the sense that he can say, "I'll take dollars away from another part of my budget," rather than do anything about this particular -- rather than respond in any other way to this particular increase in price. That's sort of like passing on the costs. He's passing on the cost to himself and hence, reducing the amount of income he has available for anything else.

Q The bottom line essentially comes out that the consumer pays?

A I would agree.

Q And the residential user pays more?

A Pays more than what?

Q The commercial or industrial user who can pass his costs on, assuming rate increases are equal?

A Well, my understanding is that the residential pays -- the residential customer pays a higher price for electricity because it costs more to provide him electric service.

Q When there's a price increase in the industrial sector, the cost of goods goes up, doesn't it?

A Yes.

Q And generally, if that company or organization wants to continue to make profits and they have no other alternative to reduce costs, they're going to have to pass the increased cost on to the customer, aren't they?

A Right.

Q And the customer is a residential user, also, isn't he?
A Yes.
Q So he's paying not only his price increase, but those costs which are passed on to him through the industrial user, isn't he?
A That's the way the economy works, inevitably. The prices of all intermediate goods and services ultimately are reflected in the prices of the final goods and services purchased by consumers.
Q Did you make any cost projections on other fuels than natural gas?
A I made projections of price increases for electricity and for natural gas and in addition, for the industrial sector, I made projections of coal and fuel oil prices.
Q On page 19 of your statement, you give us some costs of electric service, 1.88, 1.63, and .55 cents for kilowatt hours. Do those figures, 1.88, 1.63, and .55, include profits?
A Yes. I should add, perhaps, by way of qualification, that they include that portion of profits that would be derived from the rate of return to the capital invested in transmission distribution facilities.
Q Fine, so 1.88 is how much profit?
A Well, these are based on the actual figures for 1973, so they would include that amount of profit earned by the company in 1973.
Q Well, let's take 1.88. That represents what sector?
A That's the residential sector.
Q Of that 1.88 per kilowatt hour, how much is profit?

A I couldn't tell without going back to the component cost elements. It wasn't actually necessary to isolate the profit component of that number in order to come up with that number. It's not derived that way.

Q It can be done, though?

A Yes, it could be done. There are some problematic assumptions -- yes, it can be done. There are a few problems, but it could be done with a reasonable degree of accuracy.

Q Is the profit figure for 1.88, or the ratio of the profit to the figure there, 1.88, 1.63, and .55, constant for each sector?

A I don't know, because the method of analysis, as I indicated in the testimony, was to deduct the costs, the average total costs of generation, from the average revenue for each class of customers, a rough technique, but what that leaves is the average total other costs, or non-generation costs. Now, those differences reflect the rate structure that was in effect at the time, 1973. Now, to the extent that the rate structure was a good one and allocated costs -- profits, if you will -- uniformly across the customer groups, then these would reflect uniform allocations of profits to the extent that there were differentials in the rate of return allowed to one customer class or another for various reasons, load factor, or whatever. Then these numbers would reflect that. In other words, they reflect the rate structure and cost allocations that motivated that rate structure as they were in effect in 1973.

Q Are you able to accommodate a sector figure such as 1.88 in

your model?

A This number was one component of the estimate that I made of the total future costs of electricity to the residential sector. The analysis of price effects on a sector by sector basis requires estimating what might be called the average price or the typical price of electric service to the customer in each of the categories, or in fact, measuring the change in price from the base year, so I used this 1.88 in conjunction with other numbers, to develop that estimate of future price.

Q The same is true of the other two?

A Yes.

Q Can you crank one in exclusion to the other for purposes of your model?

A I could crank any number in. I cranked 1.88 into the residential because that was the number that I derived from the average residential revenue figure for '73.

Q Who gave you those figures?

A Those are based on the published statistics of the company.

Q Where did you get them from?

A From the Uniform Statistical Report submitted to the Edison Electric Institute.

Q That's 1973?

A Yes.

Q Do you know what they are now?

A No.

Q Are those figures published yearly?

A Yes, they are.

Q '74 is published now?
A Yes.
Q And is '75?
A '75, yes. Well, I take that back. I think the '75 figures probably won't be out until April of this year.
Q Do you have any idea of what the '75 figures are going to be?
A No. You see, this analysis was directed to showing over a long-term period, say a 10-year period, what the effect of prices could be. I wasn't concerned with tracking the change from '73, '74, '74 to '75 specifically. I was interested in the longer view, so at the time I started the analysis, '73 seemed like a good year to start with, just before the energy crisis. It would make a good base year. I wanted to carry the look out into the future, say ten years, and see what the effect of prices might be. It really wasn't necessary, I felt, to go back and redo the analysis when the '74 numbers came out. The illustrations, the numbers, served the purpose adequately based on 1973.
Q You didn't compare '74 numbers to '73 numbers, although you started your work in '75?
A At the time I started the work, the '74 numbers had not come out. I began with '73. Besides, as I say, I think '73 is perhaps a better year, anyway, because it's pre-energy crisis.
Q Although it's a pre-energy crisis, as you term it, isn't it true that the rates since '73 across the United States have increased significantly in all sectors?
A Yes, they have. If I had taken '75 as a base, you see, I'd have to be measuring the increases that went on top of those

increases. It might be better to start with the lower electricity rates and measure the increases that would come from those lower ones, because in effect, then, what we're saying is that we're having larger percentage price increases starting from the lower base and if we'd started in '75. Another thing that's important here is that some of the changes in prices that went on between '73 and '75 will continue to have effect in the future. If I had just started with the '75 base year, then I would either have had to neglect the continuing influence of the past changes between '73 and '75 or of trying to build them in somehow. The easiest way to build them in is just to start with '73 and take account of them by means of a long-term view.

Q Of course, now, if we are consistent with your earlier testimony, when you get to the point where we have the straw that broke the camel's back and price increases, the higher the price increase, or the higher the actual price for purposes of application to your model, the more you may expect a response of demand?

A The way the model works out -- let's just assume that if we started with 1975 instead of '73 --

Q Let's assume, say, some figures. Let's assume we've got 3.2 instead of 1.88.

Q The question as to the way the analysis would change would depend upon which increased more between '73 and '75, gas or electric prices. If gas prices went up more rapidly than electric, then the effect would probably be to alter things a little bit in favor of gas; in other words, against

electricity growth. If it were the other way around, it would make a little difference against electricity growth, the reason being that if you started with a '75 base then, you'd have a higher relative price increase for the fuel which increased least between the two periods, between '73 and '75. As I say, there's nothing wrong with starting from '73, which automatically takes into account in a long-term framework, the price increases that we've observed between '73 and '75 and further expected price increases in the future.

Q Of course, since 1929, we have not had as great price increases in such a short period of time as we have had since 1973 to the present, isn't that true, insofar as electrical prices are concerned?

A I don't know whether the rate of increase for electricity prices has been higher between '73 and '75 than in any other two-year period since the 20's. That may be the case. I haven't looked at the historical time series. Of course, one thing you have to remember is that also, other prices have been rising quite rapidly so that the price of electricity in real terms, or deflated, hasn't been rising nearly as much.

Q Do you know what the price increase has been for any of the members of this consortium per kilowatt hour in any sector?

A From '73 to '75?

Q Yes.

A No, I have not made an explicit investigation of that 2-year period. I might say that nationally, the average price of electricity -- let's take the retail price, anyway -- has pretty much tracked inflation. It's gone a little bit higher

that inflation, but if you take out inflation, the electricity has gone up very little in real terms.

Q Do you know what the BPA rate increase was to its customers last year?

A To its wholesale and industrial customers?

Q Yes.

A No.

Q Would it surprise you if I told you 36%?

A No, because here you're talking about a customer group whose costs are largely tied to the generation costs. They would be higher on a percentage basis than, say, for residential customers.

Q Is it more expensive to run a hydro facility or a thermo facility?

A Well, based on historic and current costs, I think it's clear that thermo facilities are considerably more costly.

Q Turning to page 22 of your statement, line 3, over what period of time do you raise gas rates from 1.80 to 2.80?

A The figures in lines 3 and 4 represent the alternative estimates I obtained for the increase in gas prices; in other words, the 1.80 is not a base year figure, it's an end year figure, to be compared to the actual average cost of gas in 1973.

Q When does it get to 2.80?

A Well, the calculations I made were based roughly on a 1983 end year. The fact is, there's a lot of uncertainty as to what's going to happen in terms of the growth in energy prices, but for rough estimation purposes, one could call

this 1983.

Q One thing, of course, would be the discovery of additional reserves of natural gas?

A Yes, if, for example, by some great stroke of luck one were able to find gas at a dollar an Mcf in large quantities somewhere in the West and pipe it up to Montana, of course, that would make a difference. I might point out, of course, that the lower figures do assume a dollar in Mcf average cost for gas, which to me, at this time, looks pretty optimistic, by 1983.

Q What degree of significance do you attach, or what degree of reliability would you attach to your increase over the period from '73 to '83?

A I think there's a lot of uncertainty as to where prices may go. My feeling would be at this point that probably a dollar per thousand cubic feet as an average cost for gas in 1983, in 1973 dollars, I might add, is conservative, given the cost of gas today from Canada and the expectation that it will probably go higher, given the current prices for intrastate gas, given the pressure that seems to be mounting for some form of deregulation or perhaps modified regulation of interstate gas, given the high costs of LNG or Arctic gas, should it become available, given the high costs of producing pipeline quality gas from coal, synthetic.

Q Did you consider curtailment of the industrial use of gas?

A Yes, I did. For purposes of this analysis, I assumed that gas would be available for any residential or commercial customer that chose to buy it. I assumed that gas would be used

in relatively lesser amounts by industrial sector users in the future, owing to curtailments. I may have been still too liberal in the assumptions that I made. I assumed that 50% of the energy use in the industrial sector in 1983 would still be accounted for by gas. If that percentage were to go down, the effect would be to increase the upward effect upon electricity demand of the deteriorating terms of availability of gas.

Q Are you aware of any curtailments in the use of natural gas by industries in the Montana Power Company service area within the last five years?

A I'm not aware of what specific curtailments have taken place. I would assume that probably some interruptable customers have been curtailed. I know that there is considerable concern about curtailment of gas supplies from Canada in the future which would, I assume, translate into fairly major curtailments for industrial customers.

Q Are you aware of any intertie arrangements for delivery of electricity to Canada in the Pacific Northwest?

A I think there might be one, but I don't know a thing about it.

Q Have you ever been shown by any representative of the applicant the geographical service areas for each of the five members of the Colstrip project?

A No.

Q Have you ever read the environmental analysis submitted by Westinghouse on behalf of the applicant?

A I've read parts of it, very few parts of it, primarily, those related to the need for power question.

Q You never skimmed over the pretty pictures showing the service areas for the various members of this consortium?

A It's possible that I did, but I don't have any explicit recollection of it.

Q Did you ever compare the rates per kilowatt hour between Montana Power Company and any other members of the consortium by sector?

A No, I did not.

Q Turning to page 26 of your statement, starting at line 23 and that paragraph following, you speak of a range from 7% reduction in electricity demand in the low gas cost case to a 12% in electricity demand in the high gas cost case. Do you know, assuming that a 7% reduction is used as in the range which you have given, what would be the effect insofar as the Montana Power Company's need would be at the end of that 10-year period?

A No, because I made no analysis of the overall growth rate nor did I make an analysis of the resources that would be available to meet the projected demands.

Q All your projections, really, are based upon specific formulas?

A Rather, one might say, an unspecified base line forecast.

Q So it's a formula applied to an unspecified base line forecast?

A That's right. It says that the effective price is about the base line forecast -- could be to raise demand by 1% a year over a 10-year period or to lower it by 7/10ths of a percentage point over the 10-year period in the two cases examined. It

doesn't -- I didn't make any attempt to develop a full-fledged sales forecast that would predict an actual kilowatt savings.

Q And no matter what your forecast formula is, it's only about as good as the basic assumptions that you use?

A Well, that's too bold a statement, I think, because in economic forecasting, it's often easy to be wrong for the right reasons, and right for the wrong reasons, so sometimes you can make a lot of good assumptions and wind up with a crummy answer, and vice versa.

Q That's what we've been hearing from Washington, D.C. economists, isn't it?

A Could be, some of them.

MR. SHERIDAN: I'm getting about to the end of my cross-examination. Could I have a couple of minutes?

HEARING EXAMINER: Yes.

(PAUSE)

HEARING EXAMINER: Very well, we will continue.

Q Dr. Anderson, were those figures that you generated on page 22, line 3, only for the State of Montana?

A Yes. The base year figures were based on the company data that I obtained from the EEI reports and the projected transmission distribution components of total cost were based on historic company figures. I assumed that those elements of cost would rise over time at the same rate as inflation.

Q In analyzing the effects of a change in price upon demand, speaking strictly price elasticity as opposed to cross-elasticity, do you apply that to a change, for example, from a rural to an urban population?

A The statistical analysis that we have done to date includes the percent of population in the area that is rural as one of the variables in the model; however, the price effect portion of the model is not directly tied to the urban-rural factor; in other words, they both enter into the overall relationship, but the price relationship itself is separate from the rural-urban relationship, so there's nothing in the model that would accommodate the possibility that the price elasticity is different in a rural area as versus an urban area. Our models just aren't sophisticated enough yet. We haven't figured out good ways of measuring that or confirming whether it would make any difference.

Q In other words, there's no direct cause and effect relationship between the change in price and rural elasticity and the change in price between urban elasticity?

A That's right. The elasticity is assumed in these models, not only in the models that I've developed, but in any other one that you would find anywhere. It assumes that the price effect would be the same. There is a kind of indirect influence in that, as I indicated before, the price effect in the residential sector is partly dependent upon what saturation levels actually prevail, and I gave you the illustration about the influence of the price of gas on electricity demand, depending upon how much saturation of gas there is. Well, if there tends to be more gas saturation in a rural area versus an urban area, or the reverse, which is usually the case, because gas availability is usually less in rural areas, in many parts of the country, that would indirectly have an

effect on the way price influences work themselves out, because it would be reflected in the overall saturation levels in the market. There would be less gas saturation, hence, less potential substitution from gas to electricity.

Q What assumptions did you make, if any, in the change from rural to urban, for the State of Montana, in the Montana Power Company service area for the years 1973 to 1983?

A The analysis of price effects that I conducted takes no account whatever of any possible change in urban to rural, the urban to rural mix. As I say, the price effect is assumed to be the same. With the kind of models we have, it wouldn't make any difference to the outcome what you assumed. You'd have to have a more refined model.

Q Would your model take into consideration the effects of income growth?

A As I indicated earlier, the work that I did for Montana Power looks only at the influence of price about the base line growth rate, if you will. The influence of income, the influence of urban versus rural shifts, the influence of any other demographic change that you might think of has to be assumed into that base line projection; in other words, if you want to have a good forecast, you've got to have a good base line forecast, and then I can tell you something about what prices would do to that base line.

Q So you're relying upon their base line forecast, not your own?

A Anyone who wanted to take the estimates that I made and apply them to the forecasts of the company would have to have confidence that the base line projection that he was starting was

acceptable. I didn't have to know what the base line projection was in order to do my analysis.

Q You've stated previously that a mathematical model is not definitive for load forecasting, is that true?

A That's true. I think the final step in making any forecast is a judgmental step. Regardless of the amount of formal analysis that you've done, you finally have to make a guess, because you're talking about the future, and the future is inherently unknown.

Q You'd even have to consider things like propaganda campaigns?

A There is such a thing as a self-fulfilling prediction. One has to consider all possibilities.

MR. SHERIDAN: I have no further questions.

HEARING EXAMINER: Mr. Bellingham, any redirect?

Redirect, by Applicants

By Mr. Bellingham:

Q Mr. Anderson, there have been some questions asked you regarding some rather technical terms, some of which have been defined previously, and some, I think, there may be a question as to whether they have been defined, so I'd like to start off my redirect by asking you the meaning of a couple of terms that have been thrown around this afternoon by Mr. Sheridan. I think you did define what trend extrapolation was, did you not?

A I tried.

Q Going one step down the road, you talked, and were asked questions about an exponential trend or growth, do you recall

that?

A Yes.

Q And I don't recall that you ever did define what you meant by that. I'm not certain whether your definition might be the same as Mr. Sheridan's, but let's assume that it is.

MR. SHERIDAN: Well, let's hear it.

A An exponential growth trend is one in which the growth from one period to the next, say, one year, is the same percent of each year's actual sales; in other words, an exponential growth of 10% means that next year's demand is 10% more than this year's, the year after and the year after will be 10% more than next year's, and so on, at some constant percentage rate of growth. That's called exponential growth.

Q Now, then, another term is linear growth or trend. What do you mean by that?

A Linear growth is growth where the addition to sales between next year and this year is the same as the addition to sales in the next year succeeding; in other words, if, say, you're adding a million kilowatt hours a year this year,you're adding a million kilowatts next year and a million kilowatt hours the year thereafter.

Q The same every year?

A The same every year.

Q Now, then, the term, econometric modeling, what is your understanding as to what this means?

A Econometric modeling is simply the use of mathematical equations and of statistical data to analyze economic problems.

Q This is not new to load forecasting? I mean, it's been used

in other economic studies previously?

A The econometric technique has become widespread as a means of analyzing problems only since the advent of the computer, which makes it possible to crunch all those numbers without going mad. The application of econometric modeling techniques to load forecasting is a relatively new development, within the last couple of years, I would say.

Q When you say couple of years, would you say two years or so?

A Yes.

Q And you are involved in this type of methodology, are you not?

A Yes.

Q And how long have you been involved?

A I became involved with this work, this type of work, in the energy area, in 1971, while with the Rand Corporation.

Q But as far as the methodology of econometric modeling, how long have you been involved?

A I first began to study that while I was an undergraduate at the University of Michigan.

Q Insofar as load forecasting is concerned, how long have you been involved in this particular methodology?

A I became involved in the application of econometric techniques to load forecasting while at the Rand Corporation in 1972.

Q Basically, the technique that you have described, the methodology of econometrics modeling, involves, as you say, the use of mathematical equations and so forth, and can be used with a computer insofar as load forecasting is concerned, can it not?

A Yes.
Q And it doesn't necessarily need to be involved with a computer, is that correct?
A Well, in principal, not, but in practice, yes, because the amount of data manipulation that has to be done in most cases is so formidable that it just couldn't be done economically without the assistance of the computer.
Q I think you previously mentioned that you still are involved with judgment factors?
A Yes, that's right.
Q What do you mean by that?
A Well, what I mean is that once one has finally gone through the computer analysis and come up with some numbers, one has to decide whether those numbers are believable, whether they're reasonable, whether they should be taken at face value, or whether further massaging of the numbers by some sort of subjective judgmental process isn't necessary. It's the same thing you have to go through, say, if you start from a simple trend extrapolation. That's a kind of mathematical model. It's a simpler kind of model. Once you've made the extrapolation, you look at the line and you decide whether or not there are reasons for accepting that line as it is, or modifying it. It's the same kind of thing that you have to do with an econometric model. It's just that more pieces of data have been cranked into the mathematical process and you have a more complicated tool that you're dealing with, but you still have to make a judgment at the end of the whole thing.

Q And you have to make a judgment regarding each individual item that you crank in?
A That is correct. You have to make judgments as you go along.
Q If you make mistakes in judgments, if you use a trend extrapolation methodology insofar as forecasting is concerned, the results are going to be incorrect, isn't that right, dependent upon the nature of the mistakes?
A Yes.
Q And the severity of them, too, I suppose, is that right?
A Yes.
Q Turning next to your econometric modeling methodology, you have to crank in certain judgment factors, as you've indicated?
A Yes.
Q And if these judgment factors that you crank in are incorrect, then your results are also going to be incorrect to a certain degree, depending upon the amount and nature of the mistake, is that a fair statement?
A That's right, unless you're lucky and have offsetting errors, which is what you always hope for, but you can't be assured of that, of course.
Q I think you've mentioned previously that you've done some work for PNUCC, is that correct?
A Yes, I have.
Q And what do we mean by that?
A By PNUCC?
Q Yes.
A That's the Pacific Northwest Utilities Conference Committee.

Q And I think it's previously been testified to, so we will not go into detail there. Have you done any type of preliminary study for load forecastings as far as the State of Montana is concerned?

A Yes, I have.

Q Would this include the Montana Power Company?

A Yes.

Q Would you tell us the nature of this and how it came about?

A As part of the econometrics forecasting model that I'm developing for the PNUCC to help it develop a West Group Forecast, I have constructed a model, or am in the process of constructing a model, of electricity sales for the entire State of Montana.

Q And you indicated that this was a preliminary study so far, is that correct?

A That is correct. Actually, the model is still in the state of development. There will probably be refinements that it will undergo before it is actually used by the PNUCC to develop its load forecasting, and even when it is working, it will be only one element in the forecasting process.

Q Insofar as the Montana Power Company, are you aware of what their base load forecastings are for the next ten years?

A I have a rough idea of the order of magnitude of the growth rate.

Q Do you know what they do forecast?

A My understanding of the methods they use for forecasting loads is about as complete as I have given it in my testimony.

Q Let me go back. What I meant to ask is, do you know what

their percentage growth rate is for the next ten years?

A Now, I believe that the projected growth rate for all customers, including the block customers and the base customers, is something under 5%. I don't remember the precise number, whether it was something like 4½% or perhaps a little higher or a little lower.

Q If I told you the previous evidence in here indicated a base load growth of 5.6% so far as energy is concerned?

A The figure I was quoting was the average of the base and the block. I know the base load component is considerably higher than the block component.

Q Would you accept the figure of 5.6%?

A Would I accept it?

Q Yes.

A I would have no reason to disagree.

Q Insofar as your modeling study is concerned that you have done for PNUCC, did you come up with any kind of preliminary figures insofar as a load forecast is concerned?

A I have come up with a range of numbers, which must be viewed as preliminary. They are tentative assumptions that I used and that I think are roughly correct, but I used them mainly to verify that the model works, and using those numbers, I have come up with a range of growth rates that I would not wish to advertise at this time as being precisely my preferred high and low estimates of growth for the State of Montana, but I would consider them as probably somewhere in or close to the range that I would wind up with if I were doing a complete analysis.

Q Do you recall what the growth rate was?
A Yes, the extreme worst case or lowest case growth rate was on the order of 4½% each year, and the highest case was slightly under 6.3% a year.
Q This was based on what you projected as total energy sales?
A Yes.
Q Would this correspond pretty much with the Montana Power Company territory?
A Well, the model covers the entire state, so it includes the entire Montana Power Company territory and the territory of the other smaller utilities within the state.
Q When did you arrive at these figures that you mentioned?
A These I arrived at as -- they were the figures from the latest run of the model just last Friday, after the last corrections.
Q You do have here a range of figures?
A Yes.
Q What about the low range? What is your analysis of those?
A Those are based on the Department of Commerce OBERS projections of economic activity by area, and they're quite conservative, I think, quite low. The upper end forecasts that I have obtained are based upon the census series, the E Series projections, and I would tend to feel at this point that the upper end growth rate -- that the upper end of the range that I have obtained is more likely to be observed in reality than the low end, which I take to be -- well, I would tend to characterize the low end as a rather pessimistic case, although not outside the realm of possibility. I would tend to

take the upper end as a business not quite as good as it was in the past, but business almost as usual, so there really isn't anything at the upper end, beyond that, to include, say, business unexpectedly better than usual, so if I were to enter my high, my point of highest probability would be somewhere above the midpoint of those two figures, I would guess, based on the preliminary analysis.

Q Would that be close to approximately 6%?

A Well, 6%, or perhaps a shade under, maybe 5.8.

MR. SHERIDAN: Isn't the midpoint 5.4?

A We could add it up and find out. As I say, I would think something over the midpoint, would be my best guess for that range.

Q You do not go into conservation to any great extent. Do you have any opinion relative to the general subject of conservation insofar as statistical results are concerned?

A The effect of conservation on demand, I think, can be broken down into two parts. One part, which I think we have gone through a period of witnessing a fair amount of, is what I would call the elimination of waste, eliminating the slack in the system as a result of the energy problems we've been having in the past few years. Many businesses and individuals have become aware of energy usage in ways that they had not in the past, and I think have sought to use it economically as possible, and in many cases, perhaps, finding it actually to their economic benefit to do so. I believe that this kind of elimination of slack or waste is likely to be a one-shot deal. Once we've eliminated the waste, then we begin to face

the question of whether or not we're going to spend money to provide additional conservation, whether we, as users of energy, or we as managers of companies, and I think it's at that point that the importance of price as a conservation tool comes into effect, and it's my feeling that if we are going to observe additional conservation in the future, that conservation will be primarily induced through responses to price, and it's that conservation that I've looked at in the analysis for Montana Power Company. That is the kind of conservation that is incorporated into the forecasting model that is under development for the PNUCC.

Q Insomuch as your analysis and your written testimony is concerned, have you assumed an unlimited supply as far as the future is concerned of Canadian gas?

A I've assumed that gas would be available in unlimited quantities to residential and commercial customers. I've assumed that because of gas curtailments, the amount of gas available to industrial customers will go down and that they will have to rely more heavily on fuel oil and coal. If curtailments are greater than is consistent with my assumptions, the effect would be to increase the amount of substitution of gas for electricity over and above what I've estimated.

Q This would accelerate, of course, electricity demand?

A That is correct.

Q Now, you've briefly testified regarding the use of 1973 figures and in one place in your written testimony, it also appears in other pages, for example, pages 18 and 21, which may include the previous statement that you made. Would your

comments made relative to the use of 1973 statistics previously also apply to your other analysis where you have used '73 figures?

A I'm sorry, I'm not sure I understand the question.

Q Do you recall that previously you talked about the use of 1973 figures and the reasons for that?

A Yes.

Q That was directed to one point in your written testimony, was it not?

A Yes.

Q And the use of 1973 statistics or figures is cited several places in your written testimony?

A Yes.

Q Would your comments made previously in response to Mr. Sheridan's cross-examination, relative to the use of '73 figures, also apply to the other usages elsewhere in your testimony?

A Yes, they would. I have taken, throughout the testimony, for a base year, the year 1973.

Q Your reasons being those that you previously testified to?

A That is correct.

Q You've generally testified on the West Group Forecast. Have you used a methodology involving the econometric modeling system? Have you applied it to the West Group Forecast insofar as your own forecast is concerned?

A Yes. I have, in the past, developed forecasts for the West Group in connection with testimony given for Washington Public Power Supply System and for Puget Power.

Q Do you recall what the West Group Forecasts were, generally?

A As of the 1975 forecast, the 10-year forecast to the operating year '85-'86, indicated, I believe, a 4.9% per year growth rate from the year, from the projected operating year 1975-76 figure to the projected '85-'86 operating year; however, if you take it from the actual base or from the actual operating year, '74-'75, the average annual growth rate is a little higher because of the depressed level of demand in that year. It works out about, I think, 5.2 or so, 5¼% per year.

Q What forecast are you referring to?

A I'm referring to the West Group Forecast of last year.

Q To distinguish the West Group Forecast from your own, have you applied your modeling technique to the same period of time involving the West Group?

A Yes, I have.

Q And what figures did you come up with?

A I came up with figures that were both above and below the 5%, roughly 5¼% figure. Actually, I have done more than one model for the West Group, so there's an earlier version and a later version, and the figures differ somewhat as between the two, but in both cases, the range of estimates that I have obtained, using various assumptions about economic growth and prices, is above and below the West Group Forecast.

Q Your low growth rate was what, do you recall, approximately?

A The most extreme estimates that I got for the West Group were, I think, down around 3.3% each year in the worst or lowest case -- I shouldn't put a judgment on it, perhaps -- and about -- well, I'm a little fuzzier here -- I think it was about 6.5, 6.6%, maybe even a little higher at the high

and I now believe, on the basis of the later work that I've done, that that range is too wide, that neither the highest numbers, nor the lowest, are very likely, and I would tend to center my projections more on the range of about 4 to 5½%.

Q Would you consider the West Group Forecast as realistic as far as the West Group's own forecast is concerned?

A Yes.

Q I think that you testified you talked to several Montana Power people during the course of collecting information, did you not?

A That is correct.

Q Did you receive materials from them?

A Yes, I did.

Q You requested materials from them that you required in the study?

A Yes.

Q And did you receive them?

A Yes.

Q I think you stated in your written testimony regarding Montana Power's methodology of forecasting that its method is similar to those traditionally employed by most other utility companies?

A Yes.

Q Do you know for certain that your own methodology would be more accurate than Montana Power's?

A No.

Q Why do you state that?

A As I indicated earlier, in the business of forecasting, there

is more than one way to go about making one's forecast; in fact, it's probably true that any one individual or group doing its forecast for the same thing over the same future time period, would come up with a different forecast from any other individual or group, so that a variety of methods are possible, are viable. Which will come out with the most accurate guess as to the future remains for the future itself to disclose. As I indicated earlier, sometimes one can be right for the wrong reasons and wrong for the right reasons, and sometimes the forecasting method that looks like it ought to be the best doesn't turn out always to do the best.

Q I think you indicated previously that there was no one and one only valid approach on methodology?

A That's right. In fact, I personally would favor an ecletic approach, one that combined the information available from a variety of sources. There's no reason one can't draw a trend line as well as build an econometric model and talk to a lot of people and do any number of things, all as part of a program of developing better load forecasts.

Q I think you've testified on cross as to the meaning of elasticity and cross-elasticity. Insofar as the future is concerned, which of these two, that is, elasticity or cross-elasticity, do you feel is going to have the most effect upon the raising or lowering of electricity prices?

A Another way of saying elasticity and cross-elasticity is to say conservation and substitution. In the one case, price elasticity really talks about conservation, the things that you do to cut back on a particular type of energy because it's

more expensive. Substitution is switching to another type to avoid the cost of that type of energy completely. In the analysis I did for the Montana Power Company, it's clear that substitution outweighs conservation when gas is at $2.00 Mcf, and the effect is to raise the demand growth of electricity. In the case of one dollar an Mcf gas, the effective prices, as I estimated them, were for substitution not to outweigh conservation, for conservation to result in a decrease of 7/10ths of a percentage point in the growth rate. In my view, $2.00 an Mcf gas is more likely than $1.00 an Mcf gas, and I would tend to think that on balance, the odds are in favor of a perhaps zero to plus some amount of growth as a result of the combined effects of conservation and substitution, so if I were to make a best guess somewhere in that range of minus seven to plus one, maybe I'd put it a little bit above zero.

Q Would you turn to page 27? You indicate there that based on a 10-year adjustment period -- these alternatives represent a range of possible variation of minus .7 to plus 1.0 percentage point --

A Yes.

Q -- and there you're talking about annual growth rate, isn't that correct?

A Yes, that is correct.

Q Over a 10-year period -- and of those figures, you indicated that one above zero would be more realistic, is that right?

A Yes. I think my best guess would be a bit above zero, because I think the case of $2.00 an Mcf gas is more likely than $1.00

an Mcf gas.

Q Would the most likely figure be close to .5% plus?

A It could be. The uncertainties involved are so great that to say it would be .5 as versus .3 or as versus .6 or .2 is very difficult. If you told me that you firmly believed that you thought it would be plus .5 percentage points a year, I would say, "I don't have any good evidence that I can bring to bear to disagree with you."

MR. SHERIDAN: Don't tell him that, Bill.

MR. BELLINGHAM: Well, perhaps I should.

Q Turning to page 21, if you would, please, and line 18, you have used the figure of ten cents per Mcf there, have you not?

A Yes, I have, for the cost of gas produced by the company in Canada.

Q Since this statement has been prepared, do you know of any changes as far as that cost is concerned?

A Yes, I was told earlier today that as of December 1st, the -- largely because of the export surcharge on gas from Canada, the cost to the company now of gas that it produces there is about 96 cents an Mcf.

Q What would this particular new figure, the increase that you indicated, do to your calculations?

A It would raise the average cost of gas to the company and would tend to raise the overall net effect of prices on the growth of electricity demand. It would tend to shift that range of minus .7 to plus 1.0 up a bit to something higher, precisely what, I don't know. It probably wouldn't make a great deal of difference because here we're talking about just

one component of the eight total mix of gas, but it would make some difference.

Q I think you were asked on cross, were you aware of a recent block reduction insofar as the ACM is concerned and Montana Power's future demand, do you recall that?

A Yes, whether or not there had been a drop in the block components of Montana Power Company's demands?

Q What effect would this reduction have upon your study?

A In calculating the overall effect of prices on total industrial sales, I assigned weights to the price effects in each of the major sectors, mining, manufacturing, commercial, and residential. These weights were based on the relative importance of each of these sectors in terms of kilowatt hours sales. By the drop in the mining sector sales, this would have the effect of reducing the importance of the mining price effects and raising the importance of the price effects in the other sectors. Because the net effect of substitution as versus conservation is higher than in the other sectors than it is in mining, the result would be to increase slightly, again, the upward effect on electricity demand.

MR. BELLINGHAM: I have no further questions.

HEARING EXAMINER: Re-cross?

MR. SHERIDAN: Yes, a little.

Re-cross, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Dr. Anderson, who, from the power company, told you the price of gas had gone up?

A From ten cents to 96 cents an Mcf?
Q Right.
A That information was conveyed to me just this afternoon by John Ross.
Q Do you know who owns the gas-producing operation in Canada?
A Yes, I believe that is owned by a subsidiary of Montana Power.
Q And by altering the price of gas to the consumer, they can, in effect, create a larger demand for electricity, can't they?
A I believe that this price change was due to an imposition of an export surcharge on the gas by the Canadian authorities and not due to a change -- to any change in the pricing policies of the company.
Q Regardless of what the changes are, whether it be by way of import tariff or a general price rise by the Montana Power Company, the ultimate result of that upward movement, if you were being consistent with your analysis in cross-elasticity, is to create a demand for electricity, isn't it?
A That's right, but if the Canadian authorities do it, of course, the company doesn't have any choice but to live with it.
Q Or go along with it. You haven't applied your forecasting model to the '76 West Group Forecast, have you?
A No, I haven't.
Q But you do know that there is going to be a sharp reduction?
A I have heard it said by individuals who have some connection with the PNUCC that that will be the case.

Q On redirect examination, you gave us some explanation with respect to the extent that the price change in electricity will have more effect on demand than will conservation. Am I correct in that interpretation?

A Yes, on balance, it seems to me likely that the substitution effect will slightly more than outweigh the conservation effect.

Q Is it your opinion that in the Montana Power Company service area, or even in the West Group service area, conservation efforts have about peaked out?

A I think the efforts to find ways to conserve will continue, but I think the decision as to whether conservation steps will be taken will be done in the future pretty much on an economic basis. There are few opportunities that remain, I think, of the sort that we could call elimination of slack, where it doesn't cost you very much to improve your performance, where you can do something and it's relatively cheap and it may actually save you more in energy costs than it actually costs you to do it. I think now we're going to be up against the economics of the issue more squarely. If there's going to be additional conservation over what we have now, I think it's going to have to be motivated by incentives in the market place, high price incentives, in other words.

Q Do you have any idea of which of the states of Montana, Oregon, Washington, or Idaho, require that walls in residential homes be insulated?

A I'm not familiar with the building codes in any of the four states.

Q You'll grant us that it's reasonable that more homes could be insulated than they are now?

A There's no question that more homes could be insulated. They could be insulated better. My feeling, however, is that the economics of the issue will now tend to govern whether or not more insulation gets established, unless, of course, legislatures act. They can override the natural incentives of the market place or augment them, if you will, by requiring that codes change, but otherwise, I think it will be largely a matter of individual users making the decision as to whether or not what they save in energy costs is going to justify the expenditures they have to make.

Q I think we both agree that the use of power certainly can be regulated, but are you aware of any states within the West Group service area that have curtailed natural gas hookups for industrial purposes?

A I know that that has been the case in the past in Oregon. I'm not sure if that's continuing there. I believe that Montana Power Company has also not connected any large interruptable customers for several years now, two or three years. I don't know what the situation is in Idaho or Washington. I wouldn't be surprised if there were embargos on hookups of large interruptable customers.

Q In terms of total natural gas sales within the Northwest Group Area, are you familiar with the percentage for sales to industrial users in terms of volume, as opposed to residential users?

A No, I haven't looked at the numbers.

Q You wouldn't be surprised, would you, if you would find that a great deal more natural gas was consumed by industry than residents?

A No, I wouldn't be surprised.

Q I want you to assume, Dr. Anderson, that because of technological advances in the production of aluminum, at primary smelters, that it was possible this very day for the twelve aluminum plants in the Northwest to reduce their energy demand by two-thirds. Would that have an effect on load forecasting on your model?

A The PNUCC model has built into it an assumption about the new Alcoa process, and it assumes that capacity coming on line after 1980 will use the new Alcoa process, saving approximately 25% of the traditional process. I don't know if there exists a technology that would save as much as you indicated, but the model would be capable of handling an introduction of that technology or adoption of it on whatever time schedule seemed warranted, based on some analysis that would have to be made outside the model, but it could be cranked into the model. The model is set up, in fact, to accommodate the possibility of technical change in the aluminum industry.

Q Even assuming a 25% reduction in the 40% of Bonneville's sales to the aluminum industry, that would, would it not, reduce demand?

A Well, the problem is that, as I understand it, the new technology would apply only to new capacity. I'm not aware now -- I may be mistaken, but it was my understanding that the process couldn't be applied at existing plants, that one would

to build a new plant to use the new process, or perhaps radically redesign the old plant. While it might be conceivable over some future time period to renovate all the old plants or replace them, you wouldn't get an immediate 25% reduction. All you'd do is get -- as I understand it -- a 25% reduction on new capacity or additions to, or replacements of old.

Q Do you know where the new Alcoa process is being used now in the Pacific Northwest?

A I understand that Alcoa does have a plant under construction, but that it won't be in service until about 1980.

Q Do you know where that is?

A No.

Q Mr. Bellingham asked you some questions about your econometric modeling technique and the fact that you've been using this for about the last two years insofar as the electrical producing industry is concerned, is that right?

A I've been using the econometric technique to estimate electricity demand relationships since '71. I first was involved with applications to load forecasting at the state level in 1972 at the Rand Corporation. I did not develop forecasts for individual utilities until joining NERA a year ago this last October.

Q Your opportunity, then, really to gauge the accuracy of your load forecasting models does not have the benefit of a lengthy history, does it?

A No, that's quite correct, although I might point out that one thing that I did do for the models for Washington and Oregon

in PNUCC models was, starting with the base year of 1962, run the model forward nine years to 1971. I chose those two years because we had good historical data for those two years and could therefore put reasonably accurate historical numbers into them all, and I found, running the historical model, for '62 to '71 for Washington and Oregon, that we came within 1% of predicting 1971, using the 1962 base year overall. We had -- we didn't do so well on some of the individual sectors. There were fairly sizeable errors in some cases for some of the individual user classes, but the errors did offset one another and in total, we came right in on the beam, so we have applied that kind of test to our models.

Q However, you have not had any test which involves projection accuracy subsequent to the energy crunch which you earlier testified commenced in '73?

A No, we really have to wait a little bit, I think, for the future to unfold to see just how well we are going to do with all of this econometric modeling.

Q You and I do agree upon the definition of exponential growth?

A Yes.

MR. SHERIDAN: I have nothing further.

HEARING EXAMINER: Mr. Bellingham, anything further?

MR. BELLINGHAM: Oh, I suppose I could think up something.

HEARING EXAMINER: Would any members of the public like to cross-examine this witness? (No response). If not, you're excused, and thank you, Dr. Anderson.

(WITNESS EXCUSED.)

HEARING RECESSED AT 5:10 P.M.